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approach

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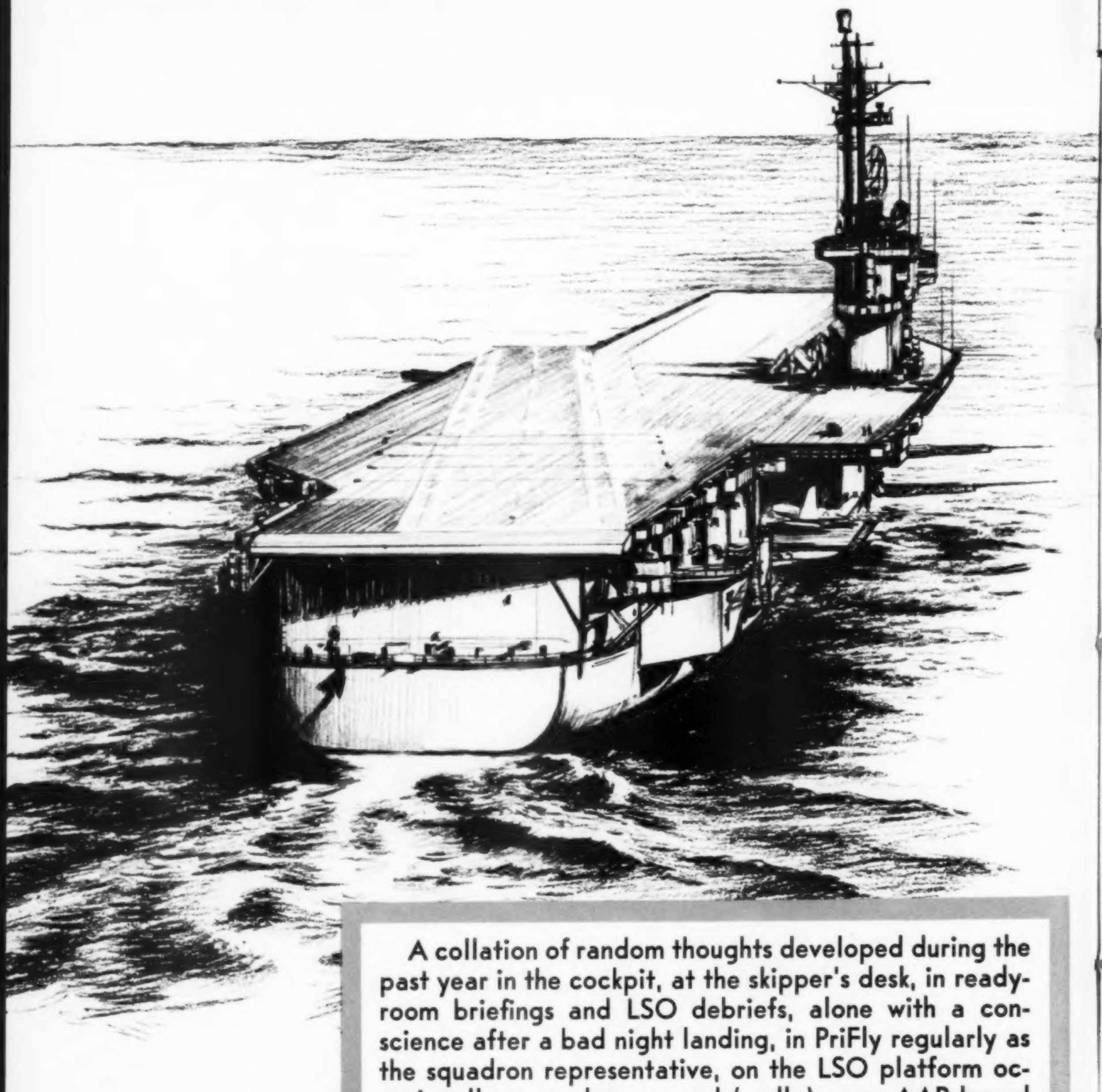


A collation of random thoughts developed during the past year in the cockpit, at the skipper's desk, in ready-room briefings and LSO debriefs, alone with a conscience after a bad night landing, in PriFly regularly as the squadron representative, on the LSO platform occasionally as an observer and (sadly) as an AAR board member after a fatal ramp strike. Part I argues the need for more specific instruction in error detection and gives a set of instructions. Part II ranges further afield and discusses the whole lens-pilot-LSO system.

Part One

THE TOTAL APPROACH

By CDR R.M. Netherland

Fundamental Instruction in Error Correction

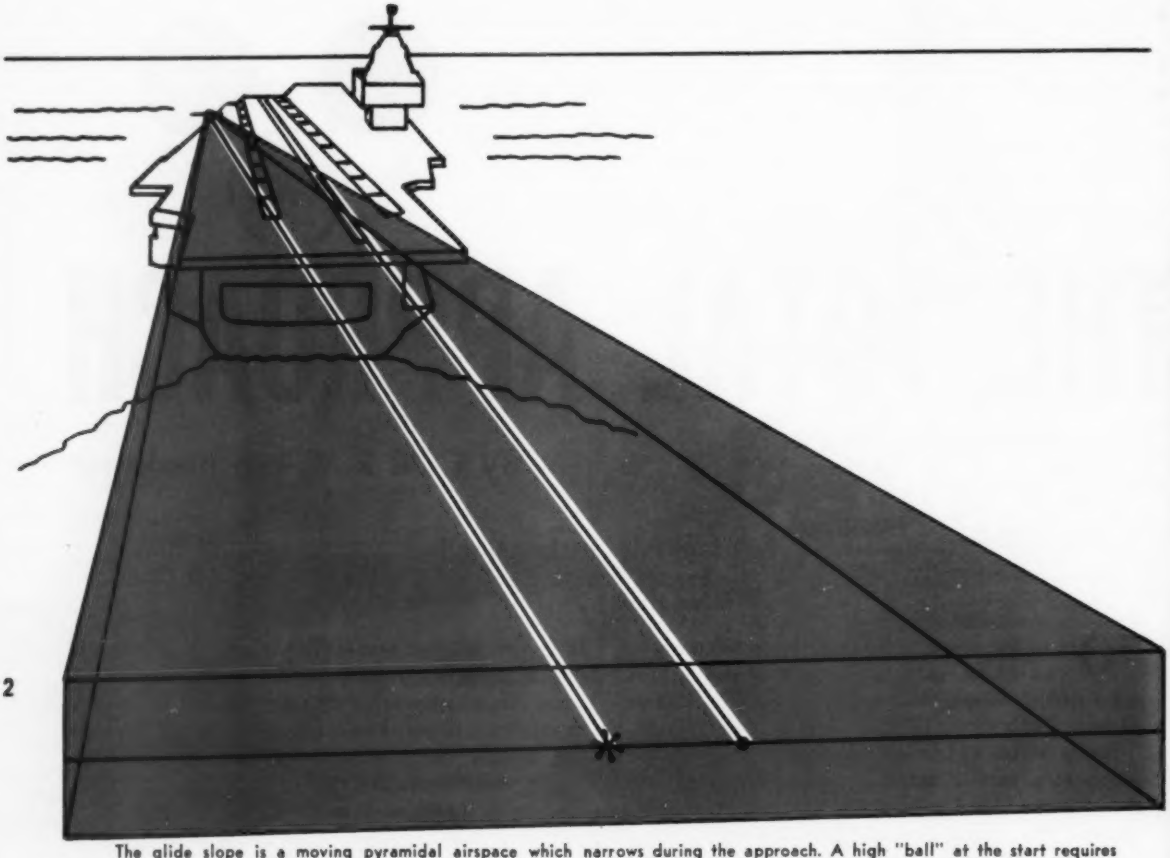
"One of the worst types of carrier accidents, and one which has tragic consequences, is the ramp strike" (*Weekly Summary of Aircraft Accidents* 27 Jan - 2 Feb 1964).

Ramp strikes and lesser accidents result from unsatisfactory carrier landing approaches. Why are there so many bad approaches? There is no simple answer. One reason may be that too many pilots really do not completely understand the problems of a carrier approach. This lack of understanding may stem from the lack of fundamental instruction in error detection and correction.

The word *instruction* is specifically used to distinguish it from *advice*. Our pilots have been given ample advice, e.g. "Fly the glide slope all the way down to the deck. It'll put you at the right place at the right time for a safe arrestment. Don't be content with anything except a centered meatball all the way. You can't miss." (From the article "Getaboarditis," APPROACH, Jan '64).

There are two serious limitations to this advice. First, it presupposes that pilots can and do fly a centered meatball all the way. Second, it states the desired result but offers no help in how to achieve it. The author feels that even the best carrier pilots do not and cannot keep a centered meatball or exactly correct airspeed all the way. Deviations occur. It is also felt that many pilots simply do not know how to make the proper correction for these variations. Their approaches are poor not because they depart from centered meatball and optimum airspeed but because they do not take the proper steps to rectify these conditions. More specific instruction is considered highly worthwhile. This instruction needs to be practical, applied to the actuality of an approach under the present lens/LSO/ship system with all its known capabilities and limitations.

The following correctional techniques are offered for consideration and (especially) discussion. They are based on experiences in an A-4 on a 27-C carrier (no APC, no SPN-10, point-stabilized lens). These techniques are founded on three strong beliefs of the author. First, that the average pilot of a high performance jet cannot detect certain approach errors as quickly or as accurately as the average LSO. Second, that the level of skill required for the newer aircraft is such that active LSO assistance rather than mere monitoring is essential for most pilots, particularly at night and under bad weather/deck conditions. Third, experience of pilots and of LSOs may change. Both may refine or even discard previously learned techniques but the techniques retained can at least be used as a starting point in creating a larger fund of knowledge comprising specific in-



The glide slope is a moving pyramidal airspace which narrows during the approach. A high "ball" at the start requires much more correction than one in close. Note that there is a double axis: one for the lens and another for the deck centerline. On a good pass, the ball will disappear at touchdown.

struction in the most demanding phase of naval aviation, the carrier landing.

There are only a few mistakes which can be made in any reasonable carrier approach. The aircraft can be high or low, fast or slow. It can be badly lined up. Its sink rate can be too great or too slight. We will discuss each of these errors, why they occur and how to correct them. To do so we must first examine some old and new statements and definitions to establish parameters:

Power plus attitude equal performance: An old rule that many pilots forget. They reduce power, maintain the same attitude and wonder why they go low.

Throttle controls altitude, nose attitude controls airspeed: Another old rule. It is not wholly valid near the ramp where nose attitude is used to correct a high situation and power is needed when slow.

The glide slope is not a slope: It is not a line nor a plane but a moving pyramidal airspace.

The Start: The area in which the pilot will perceive a distinct meatball if his altitude is reasonably

There are only a few mistakes which can be made in any reasonable carrier approach.

correct. Gross errors often appear here but there is ample time and airspace for correction.

In Close: The area in which the LSO must make his final decision as to whether the aircraft can land aboard safely. Any approach errors still remaining must be very minor ones; time and airspace for correction are almost gone.

The Ramp: Past the point where any LSO signal can be given and answered. Success or failure of the approach now depends entirely on the pilot.

The Middle: By elimination, everything between the start and in close. The heart of the approach where almost all large errors can be corrected. Any signal can be given and answered.

Elementary Corrections

High—Reduce power to increase rate of descent. Nearing the desired altitude add power to resume normal rate of descent. Maintain proper angle of attack with nose attitude.

Low—Add power to reduce rate of descent. Nearing the desired altitude reduce power slightly to resume normal rate of descent. Maintain proper angle of attack with nose attitude.

Fast—Reduce power and gradually raise the nose as deceleration occurs, maintaining normal rate of descent. Nearing the proper angle of attack add power to hold proper rate of descent.

Slow—Add power and gradually lower the nose as acceleration occurs, maintaining normal rate of descent. Nearing the proper angle of attack reduce power to hold proper rate of descent.

Inflight engagement!

Combination Corrections

When errors occur in combinations, the general prudential rule is, "if high, correct airspeed first; if low, correct altitude first." Let's review them while we are at it:

High and Fast—The correction must be started early. Reduce power considerably, get back on speed. Hold proper angle of attack with nose attitude. Previous power reduction will increase rate of descent. Be alert for deceleration or high sink rate, stop either with prompt application of power.

High and Slow—If only slightly slow, lower nose to attain proper angle of attack. This should also increase rate of descent. Adjust rate of descent with power. If grossly slow, correct with power before increasing rate of descent. An ugly situation in close.

Comment in LSO's book: "OK #3."

Low and Fast—Fully developed, it is difficult to rectify. Detected early it is fairly easy. Add some power to remedy the dangerous low condition. Raise the nose to obtain correct angle of attack. A considerable power adjustment will be necessary as you approach glide path and correct speed. An LSO's call to check attitude (if answered promptly) prevents a low and fast situation.

Low and Slow—Add considerable power. Climb, monitor angle of attack to be sure you are not decelerating. Keep power on, correct airspeed with nose attitude only after your climb is established. Anticipate the power reduction as you approach the glide slope again. Do not make subsequent power reduction too large or you'll go low again.

Combined errors can nearly always be remedied at the start of an approach, sometimes in the middle but almost never in close. Considerable time and space are necessary for a complete correction. Any fully developed combined error near the ship calls for a waveoff.

It is easy to translate one error into another by improper, incomplete or exaggerated corrections. A *Low* often becomes a *Fast* if power is left on too long. A *High* can change to a *Slow* if power is not anticipated and reapplied when reaching the center meatball. Given any error, improper correction can produce another error of at least equal magnitude later in the approach when there is less time and space available.

Now let's examine and discuss the errors in sequential order as they occur in the approach—at the start, in the middle and in close.

High Start—If you have a ball you're not grossly high. If you do not, you should have already called "Clara" and received confirmation from the LSO. Increase rate of descent by reducing power; maintain doughnut speed. As the ball starts down anticipate and be ready to add power just before it centers to resume normal rate of descent. Recheck angle of attack. Never be in a hurry to correct for a high start at night. Ensure that the ball and datum lights are well-defined before you reduce throttle. It is too easy to sink gradually through the entire glide slope

Never be in a hurry to correct for a high start at night.

if the ball is indistinct. Under certain night conditions, the lens does not give enough resolution at $1\frac{1}{8}$ miles to allow a precision descent. Some experienced pilots fly the final CCA at 500 instead of 600 feet. They say that they find the six o'clock position of the altimeter easier to maintain and prefer to pick up the meatball later where it is more sharply defined. Of course they then face a shorter glide slope with less time and space for error correction.

High in the Middle—The same corrections as before but in smaller degree. You can't be far off or the ball would have disappeared. Anticipate the lag in response to power or you will drop to a low before you stop the ball. A *High Start* or *High in the middle* is made worse by airspeed variations. *High* and *Fast* is difficult to rectify. Correcting airspeed before altitude will prevent the dangerous decelerating approach which ends with a wild call for power in close.

High in Close or High at the Ramp—It is now too late for a power reduction. You have three choices. Only one of them is correct.

You can do nothing and bolter.

You can try to center the ball again—but it won't stop in the center! The glide slope is far too narrow. The ball goes off the bottom and you hit hard on an early wire. This is a widespread misjudgement. The pilot often has no idea what he has done, saying, "But I couldn't have caught No. 1 wire. The ball was going high on me at the end." What the pilot doesn't add (because he doesn't realize it) is ". . . so I added forward pressure on the stick to bring the ball down. As it reached the center, I knew that now I wouldn't bolt and I shifted my gaze to the deck, not noticing that the ball went out the bottom." This will be discussed further in Part II.

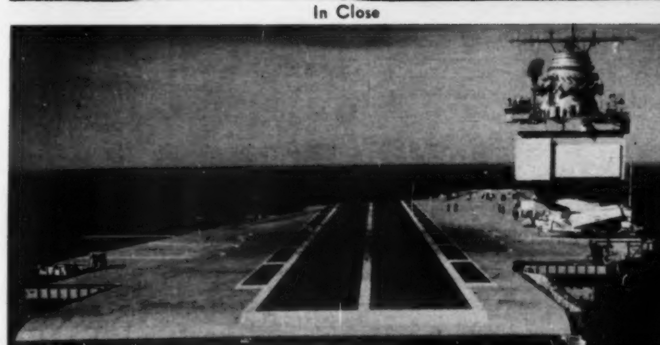
The correct procedure is to stop the meatball in its present high position, hold it there and fly it all the way to touchdown. You will catch a late wire if airspeed was correct.

Low Start—If the ball is slightly low (you see and recognize a distinct amber ball) the problem is not serious. Keep altitude constant until the ball is centered, then start down normally. Remember that length of groove has been shortened, reducing time for correction of other errors. A tight, short-groove, VFR pattern (often sought to reduce landing interval) obviously calls for a low start since the aircraft must intercept the glide slope closer to the ship. At night, the low start becomes dangerous when the aircraft is so low that no ball is seen. A pilot who ignores his altitude may mistakenly think the ball is

The Start

The Middle

In Close



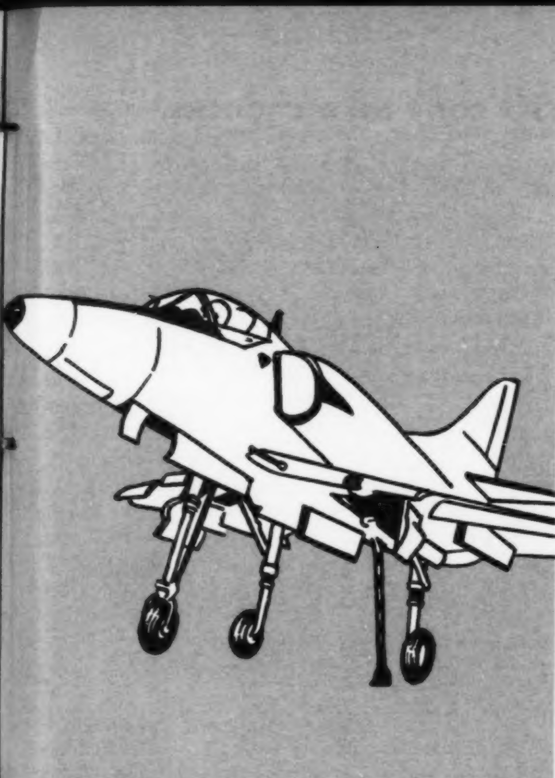
The Ramp

off the top of the lens instead of the bottom. Take no chances. *Anytime* you see no ball, assume you are low, call "Clara" and do not descend until the LSO confirms that you are high.

Low in the Middle—The LSO can't tolerate it. An urgent call for power invariably follows. This all-too-common error may result from a fast start, decelerating. Or it may be the result of a descent on an ill-defined meatball. The ball movement is hard to detect and a considerable sink rate is established through the wide slope before the pilot notices anything. An LSO generally will notice *Low in the middle* before a pilot will at night. This fact leads to the pilot saying, "Either the lens or the LSO was entirely wrong. He said I was going low and I'll swear the ball was in the middle or even a little high." The pilot should have realized that the LSO had detected a trend as yet unapparent to the pilot. The pilot would have noticed it later from the lens but then the rate of descent could have become dangerously large, precluding an acceptable approach. This is a good place to mention that if ever the lens shows one thing and the LSO says another, believe the man not the machine. There have been verified cases of a certain lens malfunction in which the ball "sticks in the middle." *Low in the middle* is answered like any other low—in theory. In practice you need a large amount of power to work back up to the center without getting slow and you have to remove just the right amount of power at the right time to avoid error translation in close to a *High*, a *Fast* or even another *Low*. Avoid *Low in the middle* and you avoid trouble in close. Some pilots report good success in avoiding a gross *Low in the middle* by setting up a 500 ft/min rate of descent on the vertical speed indicator as a first estimate of the proper rate of descent.

Low in Close—It ranges from harmless to fatal, depending on degree. It can be induced by the pilot so quickly that the LSO can do little or nothing about it. How does it come about? By forgetting that power plus attitude equal performance. Over-concentration on angle of attack can do it. With no change in power, if the pilot lowers the nose to maintain an on-speed indication, he is certain to go low. It is the only possible aerodynamic result. Deliberately diving for the deck at night (lowering the nose or reducing power) often produces ramp strikes. Don't trust your illusions of being high; they are wrong and

The best practice for a good approach is to make a good approach!



"Almost nothing makes the LSO feel worse than to watch your approach light shift from red to amber to green."

they can kill you.

If you see the ball starting to go low in close, bring it up immediately by power and a slight nose rotation if necessary. It will take some finite time for power to take effect. A large application of throttle for too long a time can cause an over-the-top bolter. If you are already at a high power setting and on speed, *Low in close* can be answered easily. If you are back on the throttle or decelerating, it can become downright hairy. As stated before, the LSO is almost helpless if you suddenly go low near the ramp. Accordingly he cannot permit the decelerating approach which may result in *Low* and/or *Slow in close*. Almost nothing makes the LSO feel worse than to watch your approach light shift from red to amber to green. Even if you're high in that situation he's forced to call for power to try to outwit you in case you should start to go low. Poor airspeed control aggravates any altitude error. Start on speed, stay on speed and altitude errors are easy to correct. A gross *Low in close* can only be answered by full power and proper nose rotation, wings level, speed brakes in (depending on model). Forget about landing this pass; you're waving off. And be glad you did; the waveoff kept you off the ramp.

Fast Start—One of the most common and most undesirable starting errors. Its bad effects come not from remaining fast, but from poor corrections necessary to correct for the *Fast* start: the small power reduction early, leading to the gradual and undetected deceleration which results in *Low/Slow in close*. There is a way to prevent the evil effects of the *Fast* start. You do it by a large power reduction immediately. You will decelerate rapidly (you may even scare yourself a little); then come back on with the power. You're on speed early with plenty of airspace and time remaining. If you then find you're a little high or low, you can solve that problem easily. The sooner you're on speed, the better the approach.

Fast in the Middle (accelerating)—This situation can occur from many causes. To correct it you must have some idea of how fast you are, your present power setting, and if you have already started to decelerate. If you can afford to take off power, do so in moderation but remember that the burble is still ahead of you and you don't want to get slow at the ramp. Time in type is a big help; you have to know your aircraft, its feel and its deceleration rate. Don't overcorrect. If you are slightly low as well as fast, a slight nose rotation should solve the problem.

Don't overcorrect

Argue later if you bolt, the LSO can't take chances.

If you are high and fast, keep coming, make moderate corrections to airspeed first, then readjust rate of descent but be prepared for a bolter. Diving for the deck is not the answer. You may catch a wire but you may collapse a strut.

Fast in Close or Flat at the Ramp—There is really no correction. The situation has developed fully and you have to learn to live with it. It requires a delicate touch. Your extra speed can carry you above or below the glide slope with the slightest change in nose attitude. You can't cushion a fast landing; you risk an in-flight engagement. You have a tiger by the tail—it's tough to let go. The LSO will probably solve the problem by waving you off.

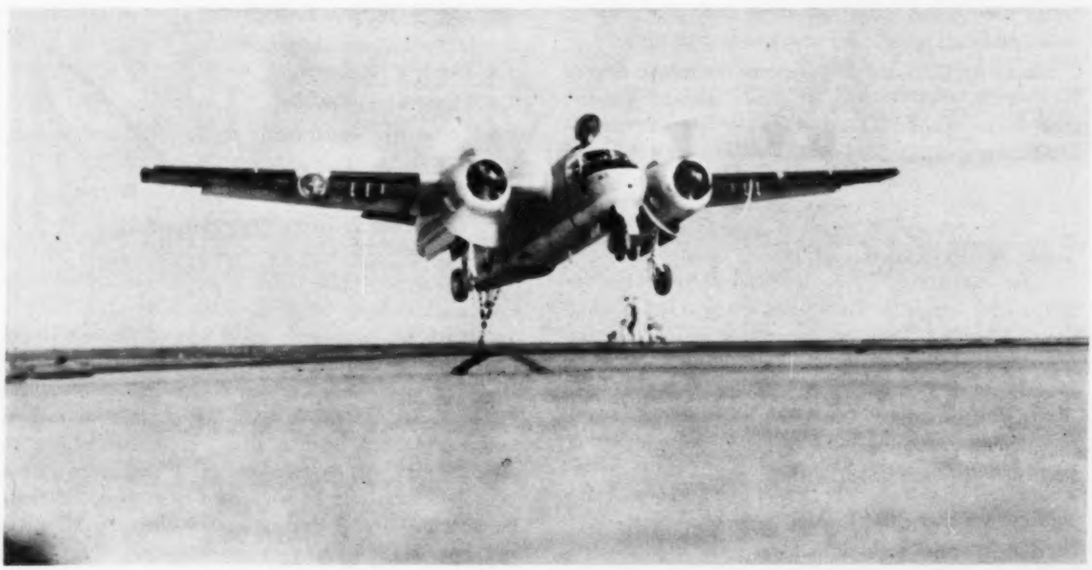
Slow Start—Everyone is afraid of it and yet it's the least serious problem. In circling approach, your high angle of attack chevron will probably change to a doughnut as you level your wings. On a straight-in, just delay power reduction until after you start your descent (nose attitude controls airspeed).

Slow in the Middle (decelerating)—A bad situation. The LSO may notice this before you do. At night he almost certainly will. No matter who sees it first, the answer is power and plenty of it. Keep your eye on the meatball to keep from climbing—not always easy to do. *Slow in the middle* often occurs after a fast or low start. Sometimes you will hear a call for power just after you have added it. Good—you have detected the error before the LSO has. Better add just a bit more in order to be on the safe side. If you hear a second call for power, pour it on—you're getting in trouble. Keep the nose from rising or you'll just go from slow to high.

Slow in Close—If the LSO has already called for power, you must answer it immediately. Argue later if you bolt; he can't take chances. If he hasn't said

a word and you see your angle of attack doughnut changing to a high chevron, add just a little power and keep the ball in the center. You're still in good shape. It is extremely hard to add just the right amount of power at the right time. Pilots usually add too much too late, leading to a climb at the ramp. A little less power added a little sooner would have kept the aircraft on speed. Most of us find that in what seems to be the ideal approach (starting on speed, on speed in the middle) we have to add some small indeterminate amount of power to avoid becoming *Slow in close*. A gross *Slow in close* can be answered only by full power. LSOs sometimes have to give a last-ditch waveoff in hopes that full power will be enough to get the aircraft over the ramp and into the wires. That signal can be defined as the waveoff that isn't a waveoff. Squadron skippers should take a long hard look at any of their pilots who have forced the LSO to use this signal. They are heading for trouble!

Lineup—Easy to master if started early and done properly. Pilots with habitual lineup trouble either start lining up too late or (more commonly) don't understand the problem. They merely align the aircraft exactly on the centerline extension of the angle, its nose pointed exactly down the angle. Then they sit there and wonder why they drift left. They don't realize that having the wind exactly down the angle is so rare that it's almost a fiction. About 95 percent of the time there will be some starboard wind component. There always is in a dead calm. On a 27-C carrire an A-4 pilot can land on the centerline by using a slight right crab. Some pilots utilize the crotch between the angle and axial decks as a nose line up reference point. This amount of crab, adjusted in minor degree, will ensure that the aircraft lands very close to the center and does not go from right to left. It is important to remember where you're going as well as where you are. Day after day LSOs have to call "Lineup" or "You're drifting left." Then the pilot's scan goes to pot as he concentrates on lineup. Pilots also come to grief on CCA when they find themselves on the final approach heading parallel to and to the right of the centerline extension of the angle. It takes two distinct turns to get lined up from that position; one to the left to get onto centerline,



Squadron skippers should take a long, hard look at any of their pilots who have forced the LSO to give a last-ditch waveoff to get the aircraft over the ramp...

'He who dives for the deck generally hits it.'

one to the right to get on proper heading. This sounds ridiculously simple until one watches a pilot in that situation merely turn to the left, aim the aircraft's nose at the end of the angle and come roaring on in, sliding right to left and wondering why.

Lineup right is less troublesome in minor degree because the relative wind is usually pushing the aircraft back over the centerline. Carried to extremes it can be disastrous on a bolter. Late lineup is a three-way trap; (a) Scan breaks down. (b) Pilot unconsciously spots the deck (ask the LSO). After a late call for lineup the nose will move up or down. (c) Although necessary, the last-minute lineup correction can be hazardous. There isn't much time for the aircraft to change its flight path. Often it lands wing-down, touching down on one wheel and greatly increasing the chances for a broken wheel or strut. One more word of caution for A-4 pilots. When the wing drops and the aircraft slips, the hook swings far out to the side. With the hook displaced thus on touchdown it will nearly always skip over the wires. Bolter! This fact can be easily verified by a few minutes watching the PLAT.

Sink Rates—The high sink rate which blows tires, smashes wheels, collapses struts and causes ramp strikes goes back to power plus attitude equals performance. Not enough power or too low a nose attitude are the only factors which can cause this sink rate. The usual manifestation is diving for the deck, consciously or unconsciously (more on this in Part II). Many pilots are guilty of this error. The suspect group includes not only those who catch No. 1 wires (especially if they say they didn't see a red meatball or even a low ball) but also:

- The "high all the way, come down at the ramp" types.
- The tire blowers.
- Those who *never* bolt.
- Those who consistently fly too fast and seldom bolt.
- Those who make late, rough nose corrections.
- Those who often go "over the top."

The insufficient sink rate produces bolters instead of ramp strikes. It's aggravating to see an aircraft look good all the way down to the ramp, then flatten out and bolt. It's usually the result of unnoticed acceleration or adding power without changing nose attitude. Speed builds up, so does lift, the ball starts up at the last minute and the wires are missed. The inherent danger is that after two or three bolters the pilot may become too determined to engage a wire (Getaboarditis). If he tries hard enough not to bolt, he certainly won't! But in doing so he may kill himself. For "He who dives for the deck generally hits it."

High, Low, Fast, Slow. Poor lineup. Bad sink rates. These are *all* of the *basic* errors. Learn how to avoid them if possible, recognize them, correct them without translating one error into another. Now in Part II we will examine some of the interrelated causal factors that change our simple solutions into complicated compromises.

THE TOTAL APPROACH

Part Two

The Finer Points

"The automation possible through modern technology is not a complete or satisfying answer to modern aviation. The answer seems to lie in a clever combination of fully automatic equipment and the reasoning power of man (APPROACH Dec 1964).

There are many interrelated causal factors which render the carrier landing art more difficult. Let us examine some of them to see how they modify or complicate the rules set forth in Part I. Then perhaps we can draw some conclusions.

The Lens

There are countless advantages of the lens over the mirror. These have been pointed out at length. There are also some disadvantages of the lens compared to (a) the mirror and (b) the ideal. Let us not pretend that they do not exist. The pilots have to live with these shortcomings and yet may know very little about them.

The lenses that the author has seen are not as sensitive as the mirror is to small altitude changes.

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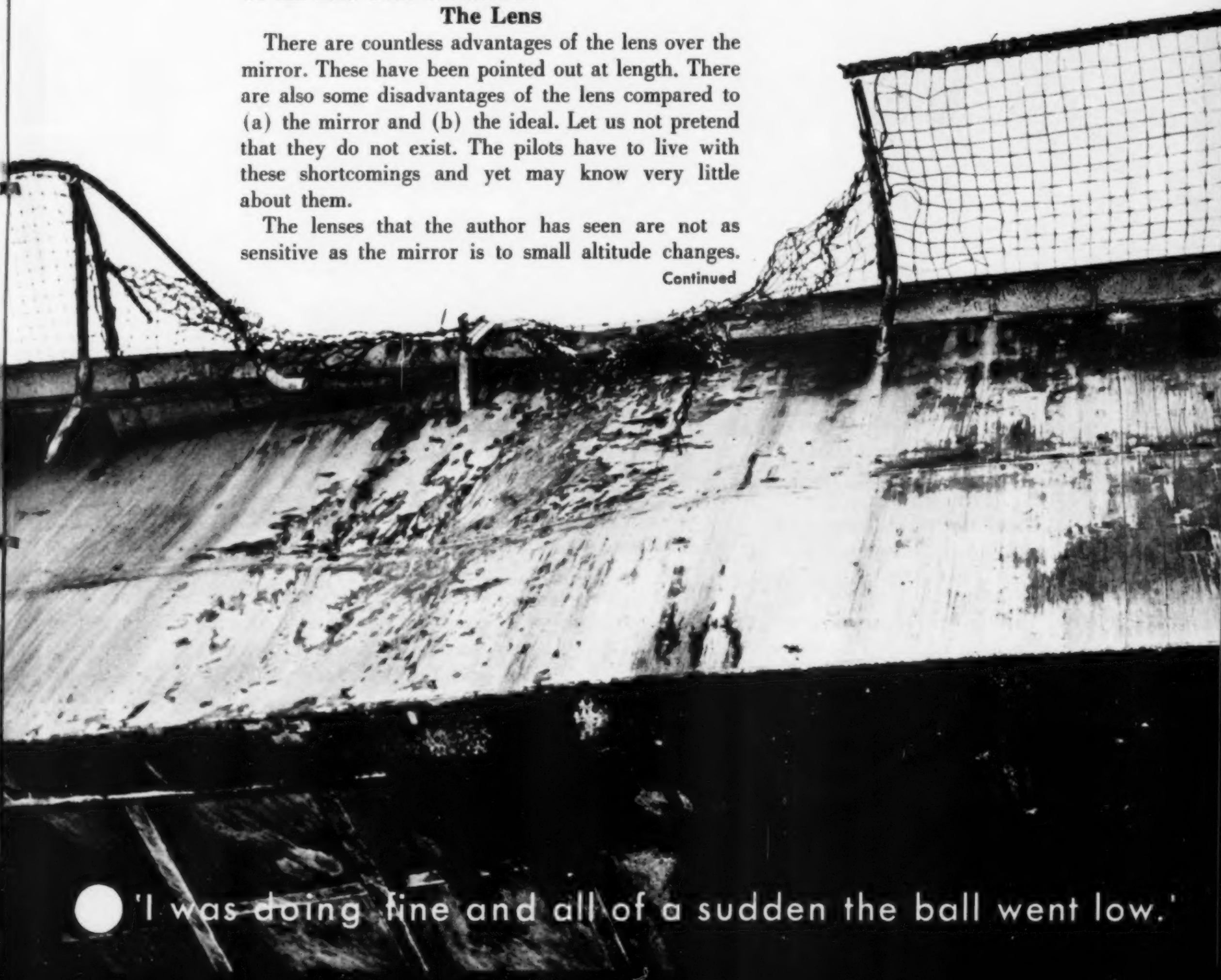
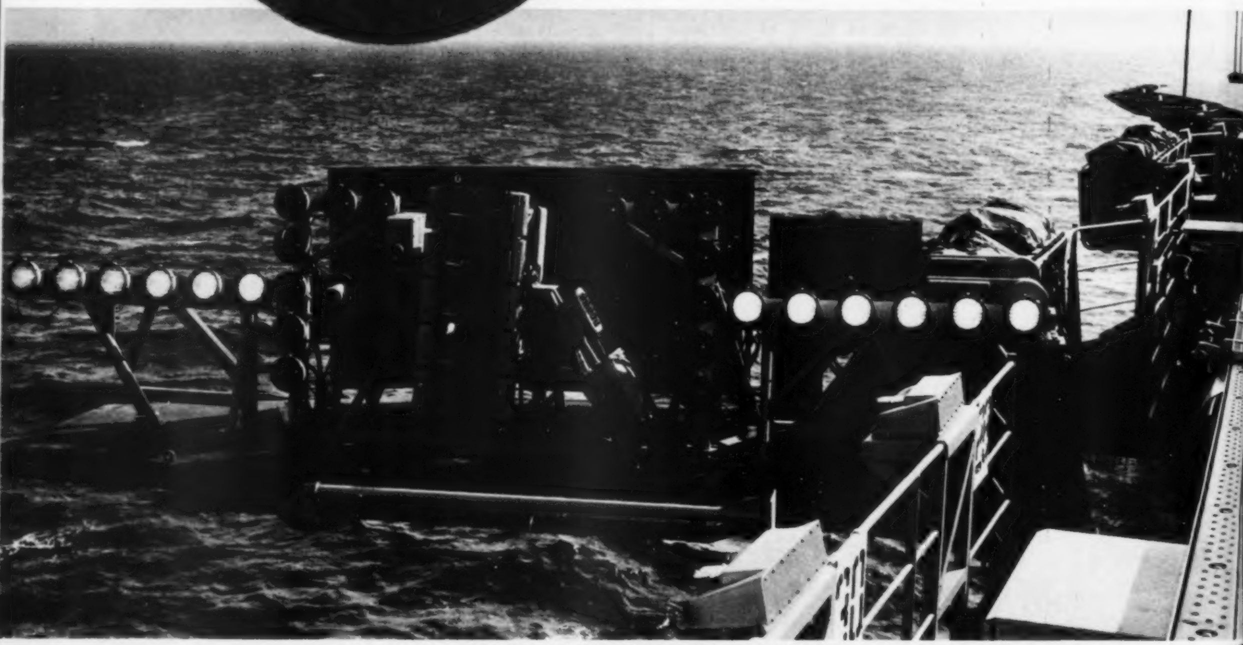




Field and shipboard Fresnel lens installations.

Using a mirror on the field a pilot can detect almost infinitesimal vertical movements. When he goes to the ship he is dismayed to find that the meatball on the lens, to quote an LSO's experience in flying, "off the top, high, centered, low or off the bottom." A pilot must learn to anticipate meatball movement on a lens—much more so than a mirror. This is difficult enough in the daytime and much worse at night. It is one reason for the numerous *Low* in the middle night passes by pilots who don't make that error in the daytime. "I was doing fine and all of a sudden the ball went low." This statement is too widespread to put all the blame on pilot technique.

Don't count on always seeing a red meatball as a warning that you are low. The color difference between orange and red may not be obvious early in the approach under certain visibility conditions. It's clear enough near the ship but by then the LSO has already called for power. Speaking of the red lens, do *you* see it every time you catch a no. 1 wire? No? Then you too, spot the deck!

One experienced LSO claims that on every ship he's ever worked, lens stabilization has been a headache. Sometimes it goes out completely. Other times it malfunctions to a lesser extent, its distortion being large enough to foul up approaches but small enough that pilots and LSOs are not immediately aware of it. It often isn't discovered until after LSO debrief of an entire recovery—or several recoveries. Other LSOs have agreed in part; others have disagreed violently.

The scene is a carrier deck on a dark night. The deck is pitching. A plane is in the groove. The LSO's voice rings out over the radio, "Okay, the deck's moving a little. Fly the ball on down but don't chase it." Herein lies one of the real dilemmas in night carrier operations. The pilot simply does not know ***why*** the ball is moving. Is it his approach or

'Okay, the deck's moving a little. Fly the ball on down but don't chase it.'

is it the deck? But what else can the LSO say! The point is that the pilot cannot obtain enough intelligence from the lens on a pitching deck on a dark night to make a precision approach. He has to have help from the LSO. In the daytime on a pitching deck the pilots spot the deck. Why deny it? At night they don't because they can't see it. The author knows only the old "point-stabilized" lens. The above remarks on stabilization and pitching deck may no longer be so important with a line-stabilized system.

Pitching decks and stabilization difficulties are two very good reasons for using the Substitute Optical Landing Systems (SOLS or more commonly, the mechanical meatball). This is a better system than many pilots realize. It has its own special limitations but in the hands of a good LSO it's better than a standard lens for landing on a pitching deck. It's nothing but a mechanical linkage from the meatball to the brain of the LSO. And to paraphrase a famous quotation, "All LSOs are equal but some are more equal than others." LSOs definitely need training to become and remain proficient in SOLS operations. There is always a verbal fist fight among squadron skippers as to whether pilots should be told that their present recovery is being made on SOLS. The author feels that it's better that the pilots not know it. Admittedly there will be more bolters (since the LSO can't run the meatball off the top of the lens to indicate a grossly high condition). Also an inexperienced LSO is apt to overcontrol the ball and cause more blown tires than usual. These disadvantages are outweighed by the confidence built up in LSOs and

pilots by everyday, routine, unannounced use of SOLS. Then when the day or night comes when it has to be used, LSOs are proficient and pilots have faith in the system, leading to safe approaches in difficult situations. SOLS remains the best way to give accurate intelligence to the pilot on a pitching deck at night.

A paradoxical disadvantage of the lens (also of the mirror) is that sometimes it can be seen too far out! To a sharp-eyed, inexperienced, slightly apprehensive youngster, the ball often will appear well beyond 1⅛ miles and will be distinct enough to appear centered. The difficulty arises if he starts to descend here, anxious as he is to get aboard. He can set up an abnormally high sink rate before he ever sees the ball start to move. As for a red ball, by the time he recognizes it as red, the LSO will be shouting at him as he's about to fly into the water. A pilot must always check his tacan distance before reducing power. If the DME is out, he must rely on CCA—also advise the LSO.

Another millstone around the LSO's neck is the necessity for continual change of source and datum light intensity throughout the day, evening and night. If the ball is good and bright when first seen, it will be too big and fuzzy in close. To get a small, sharp ball at the ramp, a pilot must accept the fact that it will be dim at the beginning. The dangerous condition occurs with overbright source lights whose loom shines up and down the length of the lens, producing the dreaded false meatball when it's really off the top or worse—off the bottom.

Even the glide slope doesn't remain constant. The LSO has to change it at some arbitrary point to adjust for high or low wind conditions. Let us say that he goes from 3½ to 4 degrees when the wind is 28 kts or more. Suppose your afternoon landing was on a 3½-degree slope with 27½ kts of wind. The night landing ahead of you may be at 4 degrees with 28 kts of wind. Further suppose that you had been using 3½ degrees for several days and nights. The change from 3½ to 4 with little change of wind may add to your illusion of being high at night. Conversely, after several approaches at 4 degrees, you may feel low when you see a center ball on a 3½-degree slope. Probably most pilots won't know the difference. However, this could very well be one of the intangible causes of, "I was doing fine and all of a sudden. . . ."

One last note on the lens: It's surprising how many pilots know next to nothing about its operation. For a quick test, ask the following: "Assume you pick up a center meatball at the 45-degree position in a circling approach. Are you high, low or at the proper altitude for staging an approach?" Or, "You're lined up right with a center ball. If you were on centerline, with no change in altitude or distance, would the ball be high, low or in the middle?" A Navy training film on the lens explains the system very clearly. (*Fresnel Lens Optical Landing System, MN-9591—Ed.*)

Wind

A factor that a pilot should always remember but seldom does until after the approach is the force of the relative wind. In a high wind, the glide slope and deck are moving away from the aircraft faster than usual. Or to be more accurate, the closure rate is less and the actual glide slope becomes shallower. It takes more power to keep from going low on the glide slope. With low wind, the actual glide slope becomes steeper and less power is required. The difference is imperceptible at the start but quite noticeable in close. In high winds, pilots go *Low in close;* in low winds, they flatten out and tend to bolt. In the daytime, pilots must learn to estimate visually the force of the wind. The LSO should tell them at night if the wind is exceptionally high or low.

Wind Indicators—A good subject for an all-day argument is relative wind and anemometers. One school of thought says, "We can build a rocket to hit the moon but we can't seem to get a two-bit anemometer to work right." The other school feels that it's all in the location of the anemometers and the interference of the carrier's superstructure. The theory is that the wind as measured by the anemometer is correct, but only for that one specific location and that the wind over the angled deck is different than the wind over the bow or atop the island due to the island's disturbance to the air flow. In any case the result is the same—wind seldom down the angle.

Burble

The best advice about burble is that it's seldom what you have anticipated. Some pilots claim that they "just squeak on a little extra touch of power in the middle and never notice it." This statement is to be doubted. The burble will aggravate the problem caused by wind force. In low wind it's feeble and an automatic correction will often be too large. Burble is an additional reason for being set up early in the approach. As a single factor it can be handled easily but if the pilot is still off altitude, airspeed or lineup, it may make an insoluble problem.

Remember, nightfall 'shrinks' the deck.

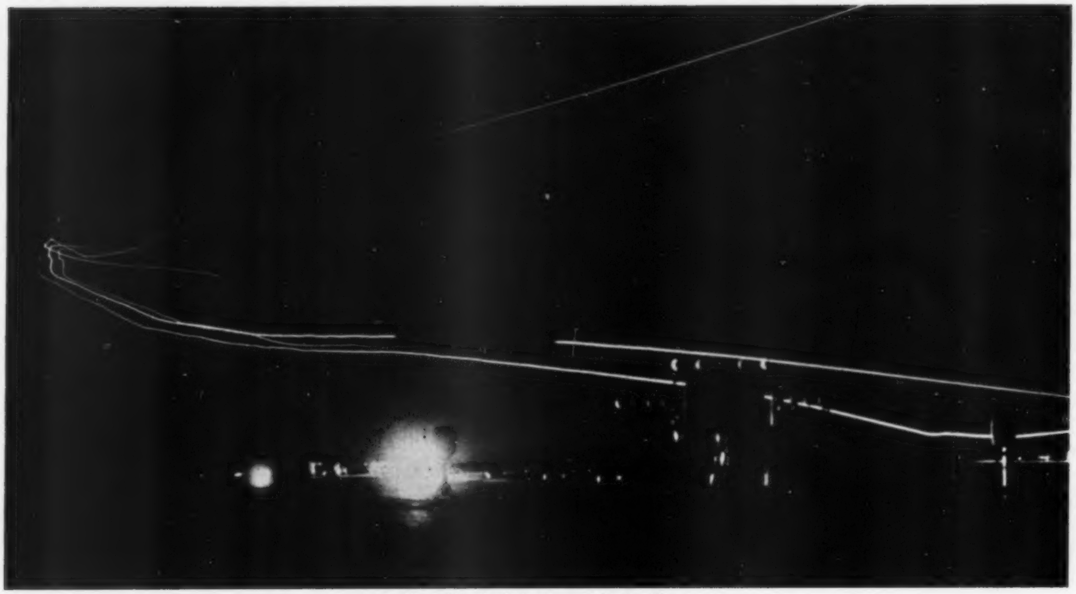
Equipment

CCA—No attempt will be made here to discuss the state of CCA except to print the opinion that without SPN-10, night CCA (without a nearby bingo field) is really limited to a minimum ceiling of about 600 feet. Lower ceilings can be handled in the daytime but 600 feet ceiling and the corresponding 1⅛ miles are necessary to give the average pilot time and space enough for a safe night approach. Some pilots can handle less altitude and groove length but many can not. In addition to this limitation of pilot skill there is the problem of CCA radar's ability to paint small targets during precipitation or around ionized clouds.

Aircraft Equipment—Radar altimeters are finally arriving for the A-4. Refinements such as rain removal keep improving the foul weather picture. But there are still shortcomings. A west coast CAW recently tested an F-8A in landing configuration at approach speeds. He found that he could vary the indicated airspeed a full 7 kts with no detectable change in angle of attack indication (approach light and doughnut/chevron). Mention is made of this fact to lend credence to the opinion that the pilot may very well not realize when he starts to decelerate. Possibly the LSO would not notice it either—except by reference to the SPN-12. And how many, many times we night fly with an inoperative SPN-12!

Deck Lighting—Changes are being made continually to improve and standardize carrier deck lighting. One inherent disadvantage remains: the outline of the deck lighting, whatever its shape, presents a *smaller* area than does the total deck as seen in the daytime. We constantly judge the distance of an object by its apparent size. How else does the pilot know he's getting closer to the deck—it keeps getting bigger and bigger. At slant range X from the ramp, the area of the total angled deck is, let us say, Y square feet. At night the area rimmed by lights is smaller so that the same slant range X, the landing area will appear smaller than Y. The pilot, having no means to measure slant range other than apparent size and relying *unconsciously* on his recollections from the daytime, may mistakenly feel that since the area is smaller than Y, the slant range (hence altitude) is greater than X. In other words, the small area seems far away and he feels too high. This feeling may recur again and again. Experience, determination to resist illusions and resolution not to dive for the deck are the answers. Remember, nightfall "shrinks" the deck.

Mirror Landing Practice Limitations—Too many



Riding the "rails" to a night landing.

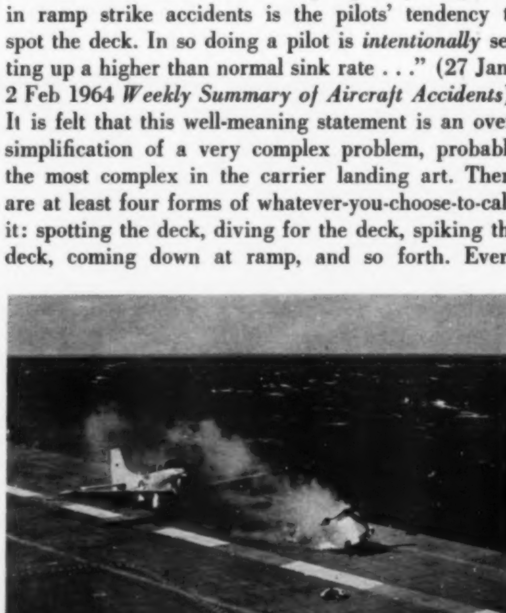
people in the carrier business feel that more MLP is the answer to all pilot difficulties in carrier landings. This feeling is even stronger regarding night landings. I disagree! Once a pilot qualifies at night and flies off the ship to any extent, additional MLP is of very little specific help. Its value lies in general adaptation of the night environment. Here are some of its limitations:

- The pilot is flying a mirror, not a lens. (*25 Fresnel Lens are currently being installed at Air Stations with carrier aircraft—Ed.*)
- There is seldom the wind velocity and direction found on the ship.
- Close to the runway, ground effect and low relative wind combine to make the pilot go high or flat. He learns to take off power or nose over to keep the ball in the center—exactly the opposite of the situation found aboard ship.
- The usual VFR MLP pattern is of no help in training for CCA. Even with a cooperative approach control it is difficult to simulate CCA ashore.

To get the most out of MLP, fly it at night, ignoring landmarks and fly instruments as much as possible from the moment of takeoff (simulating a bolter) through the 90-degree position. NAS, Lemoore, with its carrier deck lighting (other runway lights out) and lack of distracting lights in the area is an excellent MLP field.

Going for the Deck

"One cause factor which crops up very frequently in ramp strike accidents is the pilots' tendency to spot the deck. In so doing a pilot is *intentionally* setting up a higher than normal sink rate . . ." (27 Jan - 2 Feb 1964 *Weekly Summary of Aircraft Accidents*). It is felt that this well-meaning statement is an oversimplification of a very complex problem, probably the most complex in the carrier landing art. There are at least four forms of whatever-you-choose-to-call-it: spotting the deck, diving for the deck, spiking the deck, coming down at ramp, and so forth. Every



The first time a pilot succeeds in diving for the deck, his trouble has started.

pilot who has ever flown the mirror or the lens has been guilty of at least one, and probably all of them.

Diving for the Deck—Here the pilot makes an intentional effort to land the aircraft in the wires with no regard to the lens, feeling that if he continues his approach by the normal means he will bolt. It is undeniably bad and must not be condoned. Pilots who dive for the deck deliberately are either callous to the effects of the resulting hard landing on the airframe, are forgetful of the aerodynamic facts of life, or are in a situation where their desire to land becomes stronger than their professional aeronautical self-discipline. Yet, in a minor degree, it is often condoned or even laughed at. "Spiked it a little at the end, didn't you, Joe?" Why? Well, it cuts down on bolters. In the daytime many pilots are able to do it successfully time after time. They ease the nose down, then try to stop the rate of descent just before touchdown. The first time a pilot succeeds in diving for the deck, his trouble has started. He will rely on this procedure again (nothing succeeds like success). He may use it to correct larger and larger deviations or may resort to it earlier and earlier in the approach. Carried to its logical and tragic conclusion, we have the pilot who *ensures* that he gets aboard by coming down at the ramp and hitting it. Under stress a pilot who has been continually diving for the deck, though in a minor degree, may forget that when the aircraft seems to be safely over the deck as the ramp disappears under the nose, he is still up to 200 feet astern of the ramp.

Coming Down at the Ramp—The aircraft has not yet arrived at the landing area. The pilot is in that most critical area where the LSO can no longer help him and he is committed to land. He then sets up a grossly high sink rate, with stick and/or throttle. Why? It must be either that he ignores the glide slope information or that he is unable to stay on the slope. The first case is *intentional*, the second *unintentional*. The first treats of negligence, the second of wrong techniques. Coming down at the ramp deliberately seems, on the face of it, absurd. Who would want to increase his chances of hitting the ramp? Yet it is done. Again, why? Probably the biggest cause is experience—experience in diving for the deck successfully. Add to this experience the effects of overdetermination (Getaboarditis), fatigue, boredom, psychological problems, bad weather, low fuel, night and its illusion of heights, plus any other distractions, and you have a candidate for a ramp strike. The skipper, the LSO and the pilot himself must all observe the danger signs early and never ignore them as "just a bad day" on the pilot's part.

The inexperienced pilot may come down at the ramp deliberately in a panic situation. He is more likely to come down unintentionally through poor responses (usually overcorrections) to errors existing late in the approach. Examples include *Low* and *Slow* in the middle. The pilot has had to use a tremendous amount of power to get back up on glide slope. As he is approaching correct angle of attack he is afraid he will go high or fast. He reduces power too soon and immediately starts down again at the ramp where margin for error is almost nil. Another example is the gradually decelerating approach. When close in, if the pilot fails to answer a power call quickly and with enough throttle, he will come down rapidly. There are countless other examples. All of them born of inexperience, poor basic airmanship or any other cause, which represents unsatisfactory error correction. However, they are not *intentional* errors. It is in this problem area that the early waveoff is a good preventative. An even better preventative is learning to avoid gross errors and to make proper corrections early, while they are manageable.

Unconsciously Spotting the Deck—All carrier pilots do this some of the time; some do it all of the time. Many refuse to admit it. Let us see if we can develop the proof. The lens does not hang suspended in space, it is attached to the deck. The pilot *refers* to the deck many times during an approach; he uses it to judge distance, he sees the deck lights, he watches the plane ahead move out of gear, he checks his lineup, he notices the motion of the deck, he sees the ship change course. At the start of the approach this reference produces no reaction because the deck is still far away and landing is not imminent. But things change as the aircraft nears the deck. It is felt that every pilot reacts to the proximity of the landing surface when he sees that landing is about to occur. Lens or no lens, he can't avoid it. It is a conditioned response that started from the first time he landed a trainer in flight training.

As mentioned in Part I, this can be noted in a response to a late call for lineup. The pilot looks at the deck and simultaneously the nose will move slightly

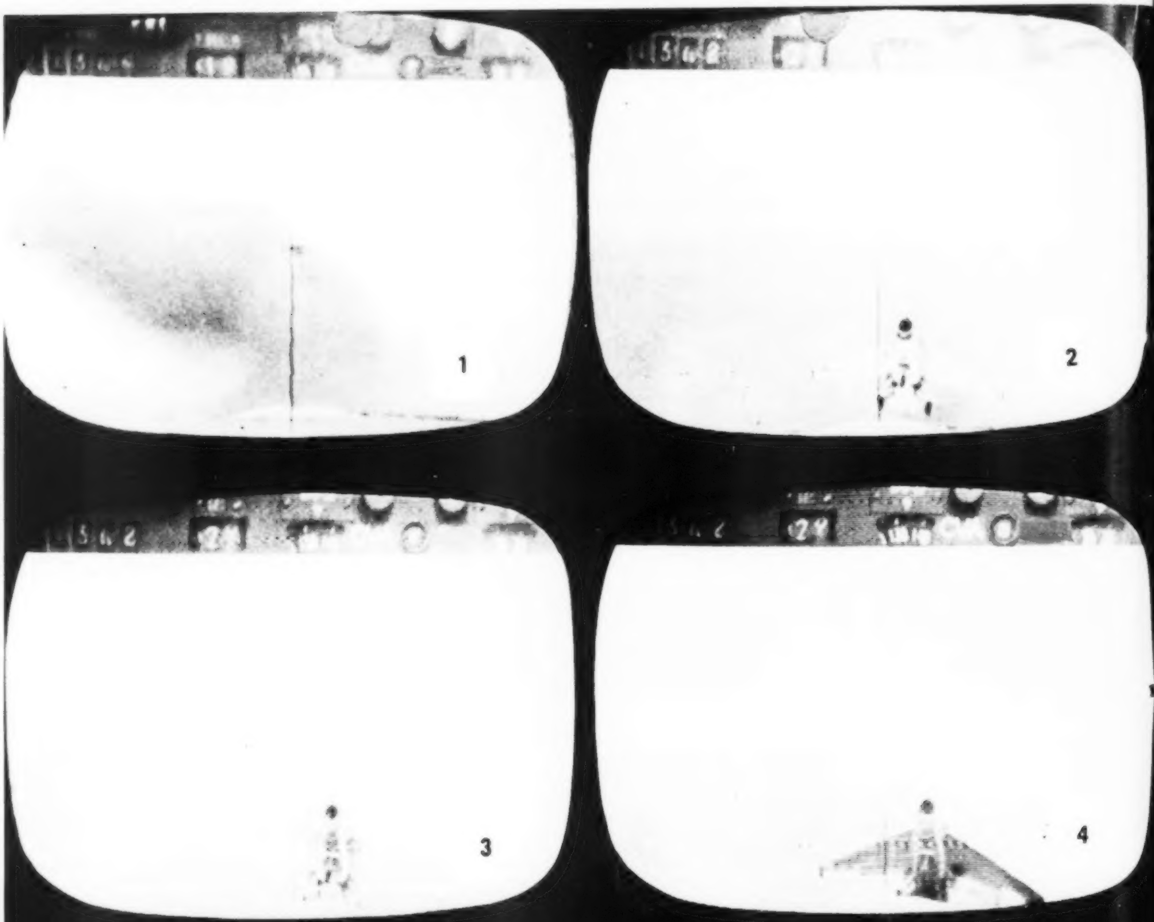


Photo number 1 is 10 seconds prior to impact. Photo number 5 is 1.5 seconds after impact. The aircraft continued up the deck and the pilot initiated a successful ejection.

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up or down as he unconsciously and immediately reacts to the nearness of the landing surface. The cure seems simple enough: "Fly the meatball all the way to touchdown." But in practice, few pilots are really able to do it completely. They know the deck is coming ever closer and unless they use a conscious effort of will, they will take a look and then react to it. We gave the example of the typical case in Part I but it bears repeating here. The ball starts high in close. The pilot reacts quickly and tries to center it—he doesn't want to bolter on a pass that was going so beautifully until this instant. As the ball approaches the center he relaxes. He knows that he won't bolt and he knows the deck is getting close. He looks at it, not seeing the sinking meatball. He reacts to the deck's proximity and he lands the aircraft by himself—usually hard and on an early wire. The pilot swears that the ball didn't go off the bottom—or even go low. For him the statement is true because it was in the center *the last time he looked* at it. Note that in the entire sequence the pilot's spotting the deck was entirely *unconscious*. Other pilots start going to the deck unconsciously as soon as they think they have passed the ramp. They are anticipating the actual moment of touchdown and looking forward to the arrestment. Experienced pilots often make this error. They know what the deck should look like at the moment of touchdown and they are unconsciously trying to hurry the aircraft into the proper position.

To fly the meatball all the way to touchdown is *not* easy. It is unnatural and requires conscious effort. If the pilot relaxes for a split-second near the ramp he will react to the proximity of the deck and spoil the ideal sink rate. It is admitted that these theories are not mathematically proven facts. Many pilots argue that the whole concept is not true, that they always fly the ball every pass, every second of the way. I think that some of them are convinced when they are asked, "Are you *surprised* every landing by the actual moment of touchdown? You should be. If you are not, if you know when you're about to hit, you have spotted the deck." It's done every day. Watch the attitude changes made just before the aircraft touches down, changes far larger than the extremely narrow glide slope demands. And to be frank about it, if pilots didn't do it the bolter rate would be even greater, especially on pitching decks.

Spotting the Moving Deck—The Air Wing of a carrier is sometimes involved in day recoveries when the deck is pitching a large amount. Often all aircraft land aboard with no difficulty at all. Does this prove that the (point stabilized) lens system works perfectly on a moving deck? No, quite the contrary! What is proved is that pilots can successfully spot the moving deck in the daytime. This success can lead pilots and even skippers into thinking that they can recover at night under the same deck conditions, which of course is not true. At night the pilots are not able to see the deck, the bolter rates go up, anxiety increases and the chances increase for a deliberate dive for the deck or a low fuel state barricade engagement following a series of waveoffs and

bolters. What is the answer? A difficult question. There is no perfect solution without a perfect stabilization system. The pilot must realize the difficulty of flying the ball all the way down and must force himself to do so. At the same time, over a severely moving deck he may have to alter his attitude at the last instant to prevent a hard landing on a rising deck or a bolter on a falling deck. Any glancing at the deck must be done with peripheral vision and with the realization that each moment not spent in concentration on the meatball is a potentially dangerous

To fly the meatball all the way to touchdown is not easy.

one that can spoil the entire approach. The LSO is still the best judge of the deck's motion.

Night Operations

It has been pointed out that almost 75 percent of the ramp strikes occur at night. This figure shows better than any longwinded argument that there are unsolved problems in night operations. It is all very well to say that pilot and LSO can reduce ramp strikes by waving off substandard approaches. But that is not the end of the matter. Why do we have so many more substandard passes at night? Throughout this article emphasis has been placed on the extra hazards of night operations. These extra hazards require extra knowledge to overcome them. An average pilot flying only during the day can violate rule after rule regarding the lens and a safe approach and still manage to get aboard safely. With practice and the help of a good LSO a pilot could easily learn to come aboard in the daytime with no lens presentation at all. But at night everything has to be just right. Let us see if we can point out some of the pitfalls and ways for pilots to avoid them by knowledge of the capabilities and limitations of the lens, the proper error correctional techniques and understanding of the intangible, personal problems involved.

Fatigue—Man is not a nocturnal animal. He is accustomed to rise in the morning, work, get tired and sleep at night. Regardless of how earnestly a carrier skipper tries to modify his ship's daily routine the fact remains that if a man is preparing to go to work late at night he is already going to be fatigued. This applies with special emphasis to men who are engaged in demanding, dangerous work and who feel some anxiety about that work. There has been much discussion about the 12-hour flying day on a carrier. But all 12-hour flying days are not the same. An 0800 to 2000 day is about half as fatiguing as a 1200 to 2400 flying day. The later the flying hours, the greater the fatigue. Put more simply, if a person is up at 0300 the chances are overwhelming that he's going to be tired. Fatigue is a double hazard. It slows the reaction time and increases the anxiety to get aboard. If a pilot can force himself to keep aware of this double hazard and fight against it, he can master the fatigue problem. As he starts an approach at night he should remind himself, "All right, I know I'm tired and I'm apt to react to mistakes a little more slowly than when I'm fresh. Therefore, I'm going to try to be set up early and as nearly perfectly as possible for this approach. I'm going to fly precisely and safely so that I can avoid any borderline situations that may require split-second crucial reactions beyond my capability. I'm going to be as alert as I can for errors and correct them as soon as possible while they are still small and I have time and airspace to effect them."

Anxiety—Fatigue and anxiety feed and grow on each other. Pilots worry about night carrier flying. They are more keyed up, more apprehensive, closer to fear than on day flights. It is useless to tell them not to worry. But they can be advised to compartmentalize and control their anxieties. The trick is not to worry too far in advance. A proper ready room brief should adequately cover every part of the flight. Now take each step as it comes. During the prelaunch period concentrate on the cockpit checks, the catapult and climbout procedures. During the flight concentrate on in-flight matters, getting the mission done. It's not time yet to fret about the landing. In the holding pattern on return, get set up and run through the approach precedures in your mind. Reassure yourself that you are going to fly a precise, safe approach, anticipating and avoiding the really dangerous errors: fast start, low in the middle, low/slow in close and coming down at the ramp. Be determined to fly safely. Do not be determined to get aboard (Getaboarditis).

Illusions—We have already discussed the height illusion. Don't let it override your faith in the lens and LSO. Also realize that other aircraft in the pattern may seem dangerously close to you when they are not. You can not judge relative distance and relative altitude with any degree of accuracy at night. A good CCA will advise you of nearby aircraft to keep you From worrying needlessly about them.

CCA—The CCA/pilot relationship must be one of mutual trust and assistance. You, the pilot, must fly the altitude, airspeed, heading and turning rate called for. Only then can the controller give you the proper vectors. A turn from an abeam position will rarely be perfect because of pilot deviations in the above-mentioned factors, controller variations and equipment limitations. In nearly all cases you *will* have to vary your angle of bank to attain perfect lineup. A good rule is to adjust your turn only after the 90-degree position. When you are well set up on instruments, on altitude and airspeed, then start looking. You should be turning to pass just astern of the DD plane guard. Check angle of bank, present heading, assigned final heading, tacan bearing. Knowledge of all four items is necessary to achieve perfect lineup.

Pitching Deck—Fly the meatball—or SOLS. If you have set up your approach properly and started down on speed you seldom will have to make radical correc-

Dusk launch.

tions, you will be on glide slope, within the proper envelope for a safe landing. Listen to the LSO and answer his calls immediately. Don't try to outguess the deck as you may have done in the daytime. It can't be done. Some pilots claim they have consistently good results by setting up a 500 ft/min descent as an "in the ballpark" first estimate of the proper rate of descent.

Foul Decks—The cause is usually beyond your control but you can minimize your losses. When you start down and you know that the deck is foul, don't give up and fly a half-waveoff. The deck may clear at the last instant. All hands on the flight deck are working as hard as they can to get it clear. Don't spoil their efforts by giving up early. Also, the best practice for a good approach is to make a good approach! You'll learn nothing by a sloppy, fast, earlier-than-necessary go-around.

Bolters—A night bolter is unpleasant but it surely is better than a ramp strike. The secret to executing one properly is having made all your traps as if you expected to bolt (full power, brakes in) and having practiced careful instrument flying following takeoffs in night MLP. Acceptance of the bolter is the first step. Except for hook skips, you should be aware when it is about to happen. You have been high/fast. The ball should have told you—if you watched it all the way. Accept it, fly smoothly off the angle, rotate nicely, maintain heading, climb and prepare for another approach under CCA control. Once you are set up, analyze your errors. Why did you bolt? It's no time for fierce, angry determination to land at all costs; it's a time for cool analysis and firm resolve not to repeat the previous error. Your biggest hindrance is your own anxiety.

Problem Detection—"It is also possible to recognize a substandard pass, or an approach which is deteriorating and initiate his own waveoff." (*Weekly Summary of Aircraft Accidents* 27 Jan - 2 Feb 1964.)

Note carefully the wording here. It definitely *does not say that a pilot will always* recognize a substandard pass. One of the hazards of night carrier approaches, as mentioned before, is the inability of pilots to detect certain dangerous errors quickly. By all means, if you feel that your approach is truly substandard, take your own waveoff. But also realize that you can't afford to waveoff every *non-perfect* pass. No one would get aboard if we accepted only perfect passes. There is a vast spectrum between perfect and unsatisfactory; the exact location of the substandard line is indeterminate. It depends on pilot experience, LSO skill, model aircraft, weather, operational tempo and every other event that takes place when aircraft land aboard ships.

LSO—In the days of the paddles approach, experienced pilots agreed generally that they were seldom surprised by a signal. They usually had detected and were already correcting an error by the time the LSO gave them a signal. It is felt that this happy situation no longer exists in high-performance jets at night on a lens approach. The LSO will detect the error first in the majority of cases.

"The LSO can accomplish this (preventing a ramp strike) by giving the waveoff on a substandard approach. In refusing to accept an approach which is marginally unsafe or one in which the pilot is not

The trick is not to worry too far in advance.

'on speed' and 'on glide slope,' the LSO can prevent a number of ramp strike accidents." (*Weekly Summary of Aircraft Accidents*, 27 Jan - 2 Feb 1964.)

You, the pilot, had better not depend on this statement to keep you out of trouble. First, the LSO isn't perfect; he isn't going to recognize every deteriorating approach. Second, at the ramp, the pilot can make a last-minute, gross, incorrect change of power or attitude which even the best LSO can't correct. There is definitely a point of no return in every approach. Third, we come to that overworked term "Tempo of Operations."

When the moon isn't out, when the weather is turning bad, when two recoveries are piling up on each other, when there's no bingo field, when there's a ship casualty, when the deck is badly fouled, when the pattern is full of low state bolters, the LSO is going to sweat blood to try to turn each approach into an arrestment. Each aircraft that goes around is a failure, another burden to the pattern, another potential low state. He can't afford to give an instructional waveoff such as he might with a divert field 20 miles away at high noon on a CAVU day during light carquals. He too is trying to measure the location of the substandard line on the landing spectrum and he will very often have to work close to that line in order to complete a recovery.

Conclusions

Are there valid conclusions which we can draw from this discussion? The author thinks that there are, some of which may be overlooked, not only by new pilots but by experienced ones, including accident board members and those in supervisory and command positions. We list them now and freely allow the readers to think about them, discuss, refine, refute or even discard them with the hope that something has been added to the body of knowledge regarding carrier landings.

- A pilot cannot be expected to remain exactly on speed and in the exact center of the glide slope throughout his approach. Deviations *will* occur.
- A pilot must be carefully taught *how* to minimize these deviations and to make corrections without translating or combining them into other difficulties.
- It is *not* easy to fly the meatball all the way to touchdown. It is an unnatural condition which requires considerable conscious effort.
- Settling at the ramp unintentionally reflects poor flying skill. Coming down intentionally shows poor self-discipline.
- An inexperienced pilot usually dives for the deck because of anxiety. An experienced pilot may do the same thing in lesser degree through poor habit patterns left uncorrected. Either case sets the stage for an eventual ramp strike.
- All pilots spot the deck unconsciously part of the time, anticipating the landing or reacting to the proximity of the deck. Pilots spot the deck consciously during a day recovery over a severely pitching deck.
- A pilot often will not recognize a substandard approach at night. He must realize this and avoid the situations which produce the most dangerous errors.
- An LSO can detect *certain* situations at night more quickly than a pilot.
- Active LSO assistance, not just monitoring, is usually required at night and under bad weather/deck conditions.
- An LSO is often forced by tempo of operations to attempt to salvage approaches which depart far from the ideal. Everyone *must* realize this fact.

CDR Netherland is a 1947 Naval Academy graduate. He commenced flight training following a tour aboard USS HENLEY (DD-762), receiving his wings in 1950.

Included in his career are tours in VS-27, the U. S. Naval Postgraduate School (Naval Intelligence) and Attaché duty in Rome. For the past 3½ years, 1100 flight hours and 250 CVA landings, he has been flying the A-4A/B/C/E. From Sept. '63 to Aug. '64 he was C.O. of VA-164. When he departed VA-164, the Commander had more than 450 carrier landings—over 100 of which were at night.

CDR Netherland's present duty takes him far away from carrier operations. Since September 1964, he has been ComSeventhFlt Staff Representative to the Pacific Command Operations Liaison Office and SeventhFlt Liaison Officer to Headquarters, 5th Air Force, Fuchu, Japan.

CDR Netherland's interest in error detection and correction stems initially from a tour as a primary flight instructor. He wishes to acknowledge that he has freely borrowed many of the ideas expressed in the article from pilots and LSOs in countless ready rooms and happy hour discussions. He extends special thanks to LT D. C. Clarke, VA-125 LSO.

HEADMOUSE

Have you a question? Send it to Headmouse, U.S. Naval Aviation Safety Center, Norfolk 11, Virginia. He'll do his best to help.

Glove Status

Dear Headmouse:

What's the latest dope on the slippery glove situation? And by slippery gloves I mean our troubles in the water in a survival setup when our wet gloves make it almost impossible to unfasten parachute releases and actuate survival equipment. Or am I alone in this problem?

WETMOUSE

▶ You are not alone. The need for summer, winter and full pressure suit gloves which do not become slippery when wet has become increasingly urgent. NASC statistics for a two-year period show 23 cases of wet glove difficulties in instances where survivors parachuted into the water or effected an underwater egress. With this in mind, the Safety Center queried BuWeps. BuWeps advises it has undertaken the following improvement program.

1. *Mark IV, High Altitude, Full Pressure Suit Gloves*—The present procurement specification Mil-G-23978 (Weps) dated 6 Jan 64, is being amended to specify a water resistant treatment for the leather palm. To be durable this treatment must be applied during processing of the leather. The amended specification will be available for the next procurement by the Aviation Supply Office.

2. *Summer Flight Gloves*

(a) Fabric/leather prototype gloves—This development was established to provide a glove with equivalent fire protection to that of the standard issue summer glove and, in addition, a non-slip gripping surface when wet. These gloves are presently being evaluated. The leather palm is treated with a water-resistant silicone treatment during leather processing. Final reports have not been received; however, preliminary reports indicate that the silicone treatment does prevent the leather from becoming slippery and that evaluation personnel have had no problems actuating parachute releases in the water. Procurement action will depend upon results of the overall evaluation. If the gloves are reported to be satisfactory in all respects, this design will supersede the standard all-leather summer glove at the earliest possible date.

(b) Standard Navy all-leather gloves (Mil-G-19919[Aer])—An investigation was made on silicone leather treatments which would prevent the gloves from becoming slippery when wet. Results of the investigation revealed that the silicone treatment was effective in making the leather water resistant and therefore improving the gripping characteristics of the gloves in water. However, since the entire glove was treated, fire protection, particularly on the back of the hand, was substantially degraded. As a result, the water-resistant treatment has not been incorporated in the specification. Further investigations are being held in abeyance on these gloves pending completion of the evaluation on the fabric/leather gloves which are proposed as a replacement.

3. *Winter Flight Gloves*

(a) One-piece Mark 5A anti-exposure gloves—The anti-exposure procurement document, WS-4723 dated 2 December 1963, presently requires that the leather be treated with a suitable durable water resistant compound. The silicone treatment which is used by the leather processors to meet this requirement, in addition to keeping the hands dry when exposed to water, also prevents the leather from becoming slippery. The treatment does not compromise the fire protection because of the insulation layer inside the leather shell. These gloves are presently being procured.

(b) Three-piece winter flying gloves (Mil-G-7496A[ASG])—The specification for these gloves does not require a water-resistant leather. The leather is identical to that presently being procured for Navy standard summer gloves except for the color. These gloves will be superseded by the Mark 5A anti-exposure gloves as a standard stock item. Upon standardization the Mark 5A gloves will be re-classified as "winter/anti-exposure flying gloves."

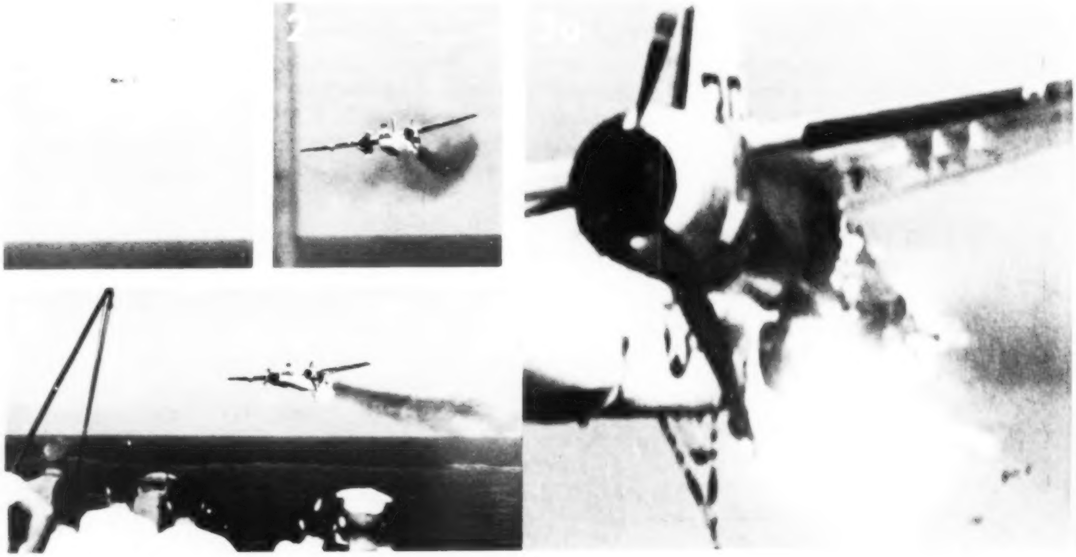
A project will be established to investigate the feasibility of applying an anti-slip treatment to the palm section of all summer, winter and full pressure suit gloves presently in the system. As soon as an acceptable treatment has been determined, an Air Crew Systems Bulletin describing the procedure will be issued to effect treatment of all gloves which have not been treated during manufacture.

Upon satisfactory completion of the above program, suitable non-slip aviator's gloves will be either in the system or available for procurement. High priority is being assigned for the accomplishment of this program.

Very resp'y,

Headmouse

INSTRUMENT DITCHING



The first indication of trouble came immediately after the free deck launch of the TS-2A for another carqual landing. Both pilots smelled a tar-like odor and noted smoke from the after compartment. A "Mayday" call was broadcast, an emergency turn downwind was started and the gear was dropped. At this time, the port engine fire warning light came on. The gear was raised and the wings leveled. The pilot, an instructor under training, noted heavy black smoke coming from the oil breather and cowl flap/oil cooler areas. The instructor/copilot, yelled, "You fly the aircraft and I'll secure the port engine!" The time—1127.

The engine fire-inflight procedures for the port engine were accomplished—mixture first, feather prop, close the emergency switches, and so forth. On the downwind leg, the pilot saw flames in the oil breather area and the copilot saw them in the aft compartment. The port fuel selector was turned off and the port engine fire extinguisher actuated. The fire subsided momentarily and then burst into flames again just prior to the 180 degree position when photo number one was taken.

A single-engine approach was commenced from the 180. The port prop had feathered; however, it intermittently turned very slowly until the aircraft reached the 90. When the meatball was picked up, the copilot placed the gear handle in the down position and changed the flap setting from one-third to two-thirds.

The wheels failed to extend!

Rather than attempt a single-engine wheels-up landing on board ship, which could have been disastrous to shipboard personnel, the decision was made to ditch along the starboard side of the ship. The pilot placed the wheel handle UP to prevent the wheels from coming down prior to ditching.

After the 90, the smoke became so thick in the cockpit that the pilot's outside vision was practically non-existent. Both pilots were on instruments and could see the water only occasionally through a clear area near the bottom of the bubble side windows.

(*It is believed that the smoke entered the cockpit through the port wingroot and then went out through the open hatches over the pilots.—Ed.*) Control forces were extreme, requiring the coordinated strength of both pilots. The rudder assist was inoperative. Photos three through five record progress up the starboard side and six shows the ditching.

Impact was hard—about 3 degrees nose-down at about 90 knots. A split second before impact, the outboard port flap pushrod burned through, causing the left wing to drop. This, plus the trailing port gear, caused the aircraft to enter the water left wing down. A left-to-right shearing force split the cockpit just forward of the pilots.

Escape from the aircraft was made immediately. The left seat pilot had no cockpit left in front of him —he merely released his belt and harness and floated to the surface.

The copilot was less fortunate. First, he pulled his broken left leg free from wreckage with his hands. Next, he removed a piece of webbing that was restraining him. After floating to the surface, he pulled the toggles of his mae west. The preserver had been punctured during the ditching and would not inflate. With multiple fractures of both legs, a dislocated left shoulder, and a broken hand, he somehow managed, through sheer perseverence, to tread water for the few seconds until the helo could pick him up.

Both pilots were on the carrier's flight deck at 1131½—exactly 4½ minutes after the first "Mayday" was transmitted.

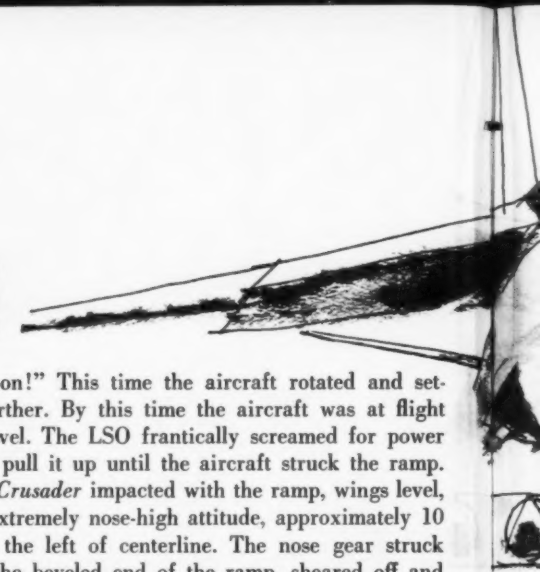
Later, when questioned as to how he managed to stay afloat, the instructor/copilot answered, "I don't know—that adrenalin is good stuff. In fact, I didn't even notice that I was hurt until I was in the helo."

Here's a couple of naval aviation's "old pros" in action in the clutch. Both knew their emergency procedures cold, and more important, put them to work perfectly. They coordinated and conducted their cockpit duties with precision as the emergency situation changed. Their ability to remain calm and to function flawlessly was truly remarkable.

Well done! Lieutenants J. W. Horning and D. J. Malone of VT-27, Corpus Christi, Texas.

TRUTH and CONSEQUENCES

JUST TOO LATE



The Fresnel lens had been checked and was operating properly with the exception of the waveoff lights. They would operate one flash for each squeeze of the waveoff trigger and then remain off until the trigger was released and squeezed again. The ship, LSO's and pilot's were all aware of this problem. Positive radio contact was established with each aircraft before an aircraft was allowed to make an approach.

About 10 minutes past midnight, Bravo 1, an F-8D, reported, "Meatball, state 30, F-8" just prior to leveling wings in the groove. When he rolled out wings level, the pilot had trouble keeping the meatball in sight since it kept disappearing under the nose of the aircraft. Raising the seat slightly corrected the situation and the approach continued.

While adjusting the seat, the pilot was distracted momentarily and the "meatball" went high. The power was then reduced to about 84 percent. As the *Crusader* returned to the glide slope, about 2 percent was added to hold the ball in the center of the lens. At this point, the angle of attack was indicating a steady "donut," lineup looked good, and the ball was centered. As the F-8 started descending below the glide slope again, conditions changed rapidly. Here's the pilot's own words as to his sensations:

"Suddenly I was seeing a low meatball!

"I had the sensation that the deck centerline lights were nearly on a level plane with me. The LSO was making repeated calls for power. There was no doubt in my mind that I was in a 'hole.' I just couldn't comprehend how I could have gotten there so rapidly. I came on with full power, rotated slightly, and considered the use of afterburner but realized that it was too late. I knew I was going to hit the ramp with some part of the aircraft."

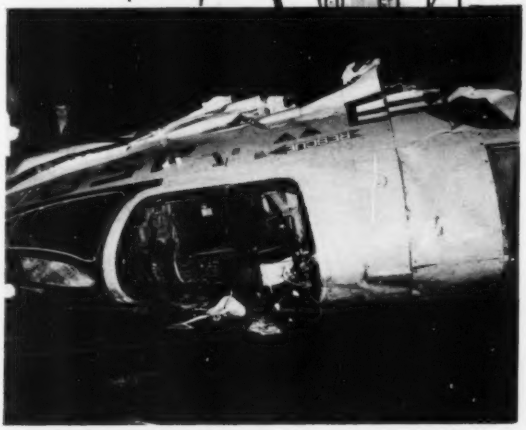
It appeared to the LSO that about 150 yards from the ramp, the *Crusader* suddenly began to settle rapidly—the approach light shifted from amber (on speed) to green (slow). The LSO called for power—no response! Again the LSO called, "power, get the power on!" This time the aircraft rotated and settled further. By this time the aircraft was at flight deck level. The LSO frantically screamed for power and to pull it up until the aircraft struck the ramp.

The *Crusader* impacted with the ramp, wings level, in an extremely nose-high attitude, approximately 10 feet to the left of centerline. The nose gear struck *below* the beveled end of the ramp, sheared off and dropped into the carrier's wake. The main body of the aircraft struck *below* the protective net. The fuselage broke off aft of the cockpit. The cockpit section, sheared from the main fuselage, flew through the air—landing just forward of the No. 4 wire. It slid up the axial deck, coming to rest abeam the aft end of the island. The remainder of the aircraft exploded and fell back into the ship's wake. Other than the cockpit section, only small pieces of debris remained aboard. The fantail and ramp were blanketed by an intense fuel fire.

The cockpit portion had come to rest relatively intact, lying on its port side next to the island. The pilot, in a semiconscious daze, was assisted from the cockpit by flight deck personnel and taken to an emergency dressing station.

The primary cause of this accident was pilot error. It is a classical ramp type accident that again serves to vividly illustrate the existing demands made upon carrier pilots throughout the final phase of a night carrier landing. Considering the severity of the accident it is extremely fortunate that the pilot is still flying today. The fuselage section, which had remained on deck and in one piece, was severely crushed and torn indicating severe crash forces. The cockpit interior had remained intact and sustained only minor damage. The pilot was in the habit of wearing his lap belt pulled extremely tight. It was the opinion of the board that this tightness materially aided the pilot's solid retention in the seat and probably helped minimize the seriousness of his injuries.

The pilot's helmet was virtually undamaged except for a deep scrape mark and a crack in the



View showing cockpit in final resting place on flight deck.

visor coverplate. The board believed that the helmet saved the pilot's head from possible serious injury either from shattered plexiglass or being scraped along the deck as the cockpit slid to a stop.

What bearing did the malfunctioning of the wave-off light switch have on the accident?

Naval operations are never completed by throwing hands into the air and quitting whenever a failure occurs. A substitute is made in either an alternate piece of equipment or a modified procedure. Safety of the operation is proportional to the success of the substitute. In this case, the malfunctioning wave-off light switch was well known by all the pilots in the air group—including the pilot involved in this accident. The LSO had briefed all pilots on its shortcoming and required positive radio contact with each aircraft before an approach was allowed to continue. Since the pilot acknowledged hearing the LSO's calls for power, and realized the extremes of the situation, the degree of contribution to this accident was in all probability very slight, if any.

It is perhaps significant to note that when the pilot was asked his opinion as to how this accident could have been prevented, he answered, "The obvious answer is *don't fly into the ramp!* The approach deteriorated from what appeared to be a good position to an impossible situation in about two seconds. I did not just sit there and fly into the ramp. I did not have fixation on any one item. When I detected trouble I took corrective action. It was just too late."

The Deadly Mk 76 War

By LT G. F. Wheatley, VA-172

In itself, the 25-pound Mk 76 practice bomb is a relatively simple and harmless tool.

Attack pilots use them by the hundreds in performing their primary peacetime mission of training for war. Training with live ordnance on every flight would be very desirable although highly impractical from the standpoint of cost and finding appropriate targets. With its low cost and comparable ballistic characteristics, *the Mk 76 is a reasonable substitute with one exception—its use!* The methods of employing it may breed contempt or a false sense of security that can be completely shattered by the explosion of one 500-pound bomb.

How then can we find ways to keep pilots constantly aware of the hazards involved in the Mk 76?

How can we insure that half of our pilots would not come back with self-inflicted holes gaping in their aircraft, or not come back at all, if they were called out on a combat mission tomorrow?

To answer these questions, let's take a brief look

The Mk 76 is a training aid and *not* a substitute for live ordnance

at our training methods, including the way we use the deadly Mk 76.

Consider first the training profiles. In most cases, minimum pull outs, release airspeeds, and other criteria for conventional ordnance are used in these profiles. The Mk 76, with an appropriate ballistic connection, is substituted for the real thing.

Here is the first big pitfall because these profiles are designed for combat. The unsuspecting weapons training officer who assumes that they insure adequate protection in peacetime is easily misled when the time comes to drop live ordnance in a training exercise.

A quick look at NWIP 20-1 will show that minimum pull out altitudes and other criteria for peacetime use of live ordnance differ tremendously from combat criteria. The difference may be so great that the old familiar bombing profiles cannot be used. Are we then saying that our live ordnance training methods for wartime have not conditioned us to use live ordnance in peacetime? Not really. If a pilot has disciplined himself to bomb correctly with the Mk 76, he should be able to switch easily enough to any profile required for live ordnance. Above all—he must know the criteria set forth in NWIP-20-1 for the weapon being carried.

Let's consider the compex environment next. Does it lead us into pitfalls when we switch to live ordnance?

The compex is the father of the canned run and the mother of the tight pattern. The goal is to get the best possible hits within the limits of the particular exercise. Most people agree that the closer you get to the target before ordnance release, the better your hits will be. Can we blame a pilot for wanting to get good hits and pressing his pull-out altitudes to the last foot? No, as long as it is the Mk 76—the forgiver of all those who pull-out below minimum altitudes. No one is the wiser except perhaps an alert flight leader or compex observer.

But—what about fragmentation patterns and the length of time that fragments hover above a bomb blast?

What would a typical tight pattern look like superimposed on the fragmentation pattern of live bombs? The intent here is not to condemn the compex system or the practice bombing patterns because they are effective methods of teaching and, improving bombing skills. The point is, can we become so engrossed in these procedures that we forget what we are really training for?

At this point, let's consider again where our training is supposed to lead us. We stated earlier that the peacetime mission is to train for war. For an attack squadron, this might simply mean getting to the target, destroying it and coming home in one piece. Getting there and coming back means little if the ordnance doesn't get on the target. Actual mission accomplishment may require precise, coordinated attacks, faultless close air support procedures and the ability to safely and accurately deliver ordnance under clouds, near mountains, while being shot at, and when given targets of opportunity. You could say that it is necessary to learn to shoot from the hip, and for this reason, the present system of training in the Mk 76 compex environment is questioned.

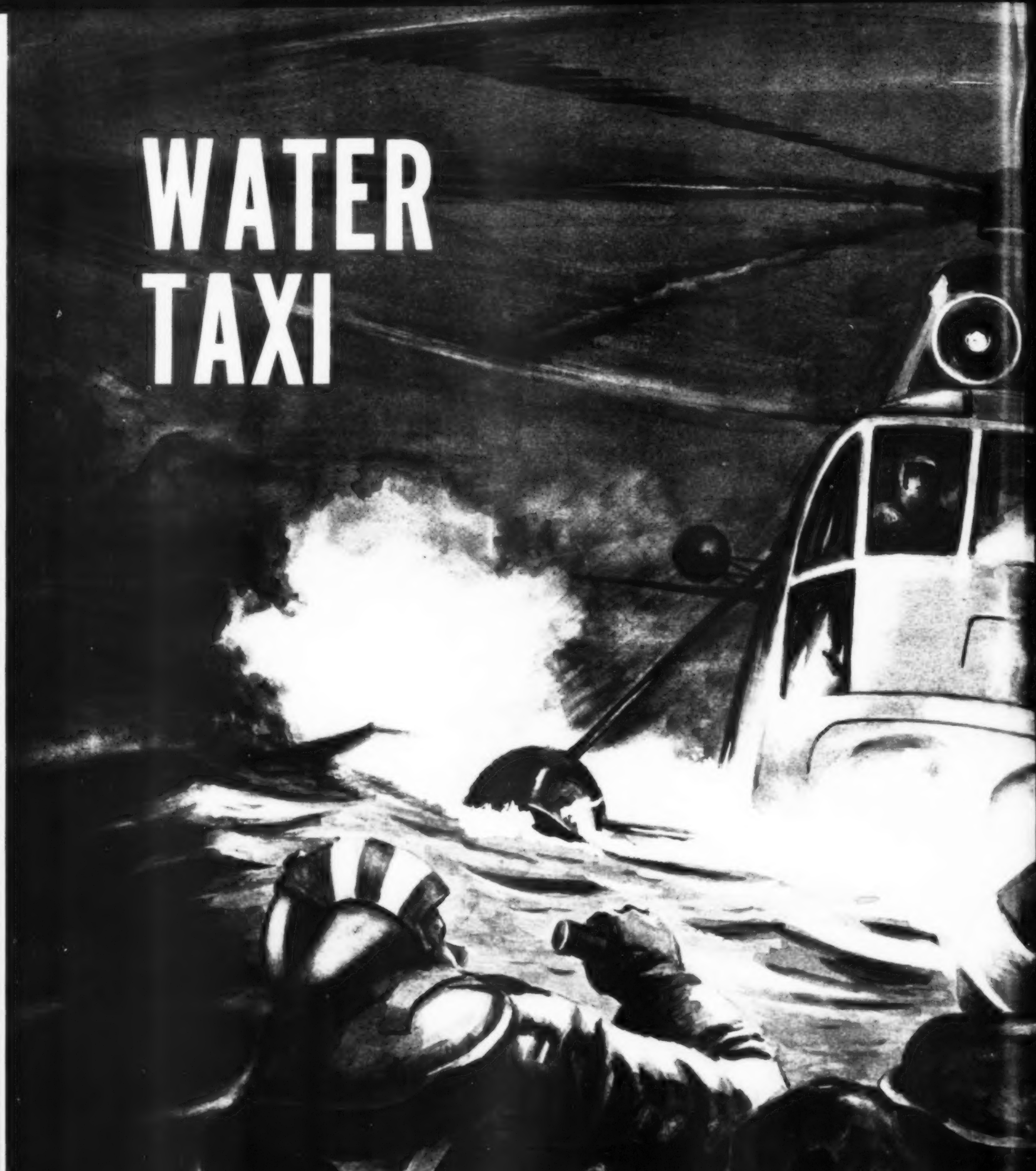
So, what is the answer? As in many other areas, the biggest single factor affecting the direction a squadron takes in its training is command attention. Along these lines, the following questions might be asked and answered:

- To what ends are the squadron objectives oriented?
- Does the squadron operations plans and the training syllabus point to combat readiness as the primary goal?
- Is the weapons training officer the most qualified man for the job? Does he demonstrate initiative, responsibility, follow-through and direct supervision or does he merely keep records?
- Do the operations officer and the safety officer continually stress the necessity for treating the Mk 76 like the real thing—do they keep a watchful eye on the pilots who push below the pullout or minimum altitude limits?

Each of these questions can be summed up into one that has the greatest importance: if every pilot in the command went on a conventional weapon combat mission *today*, how many would be there and destroy the target without blowing themselves out of the sky in the process.

It is of primary importance to understand that the Mk 76 is a training aid and *not* a substitute for live ordnance. Every attack pilot must understand that he is training to use live ordnance and not training just to merely gain proficiency with the Mk 76. If every pilot on every training flight were to mentally replace the practice ordnance on his aircraft with the appropriate live ordnance (1000 lb GP, Napalm, etc.) for that particular mission, we would see a marked reduction in the indirect casualties, later, from the deadly Mk 76.

WATER TAXI



While in the holding pattern awaiting recovery, an EA-1E experienced engine failure. The pilot made a controlled ditching at sea. Survival rescue narratives of both pilot and NAO were unusually complete in this accident. Here is the pilot's description of his experiences. . . .

As I waited for the impact, I wondered what it was going to be like. The aircraft struck the water with a "hump," two to three times the force of a normal arrested landing. During our descent I had told the NAO to tighten his straps and had tightened mine almost to the point of discomfort. As we hit, I had a quick case of vertigo. The second deceleration was less severe than the first. Water over the nose section was phosphorescent and kind of yellow-green on the windscreen.

After I was sure we had stopped, I reached for my safety belt release but missed it the first time. (At this point I saw the NAO moving in the cockpit.) I was a little concerned about sinking fast . . . remember thinking "I can still get out even if the aircraft sinks." Nevertheless, I didn't like the thought of cold water over my head.

I found the catch and opened it. Can't remember if I threw back my straps although it seems that I did. Grabbed the upper portion of the canopy and stood up without difficulty. The aircraft didn't appear to be sinking too rapidly.

Climbed up on the left side canopy railing and called to see if the NAO was clear. No answer. The right cockpit area appeared to be empty. I stepped into the water and swam a short distance from the aircraft. Turned and looked at it—it was floating slightly nose down. I then called for the NAO a few more times. Still no answer.

My parachute kept me floating almost level on my stomach. Sea state was relatively slight. Until I got my parachute harness unbuckled, water occasionally hit me in the face. I encountered no great difficulty in unbuckling other than having to try one or two of the buckles a couple of times because of my wet, slippery gloves.

Once out of the harness, I looped the straps over one arm and inflated my mae west. With the gloves on, my sense of touch was not the best. The mae west inflated to about three fourths of what I thought it should be. It popped up in front of me because my straps were not tight enough or possibly because the fasteners on the underside attached to the straps had come unsnapped.

The aircraft was still floating. I was interested in it and also wanted to try and correct my mae west situation so I swam over to the port wing and grab-

bed the little bubble covering the wingtip light. The wing tip was about a foot under water so I rested my arm on the wing and tried to adjust my mae west straps. With the mae west inflated, I couldn't slide the adjustment slide on the strap. I kept an eye on the tail section of the aircraft. As it started to rise just a little, I swam away. It nosed over to 70 or 80 degrees and sank. Seeing it go down was kind of sad.

After the aircraft sank, I inflated my life raft. My lanyard was not hooked to my mae west. I think this was to my benefit in that I did not get entangled. However, if it had been attached, I could probably have inflated the raft a little more easily. I had it undone purposely before the flight so that I could remove my parachute harness quickly if necessary.

The parachute and raft pack remained buoyant a much shorter time than I had assumed they would. I turned the pack over a few times in the water to look for the release clip for the raft and the lanyard clip. Everything felt pretty much the same with gloves on. By this time the pack had zero buoyancy and I could maneuver it at will beneath the surface.

Decided to take my gloves off. Saw tracers being fired by the NAO so was relieved to know that both of us were alive. When I got my gloves off, tried to put them in the lower left leg pocket of my anti-exposure suit but the zipper was hard to operate. Rather than throw the gloves away, I held them between my teeth. With my gloves off had no trouble finding the release clip and the lanyard. Pulled the lanyard in hand over hand. Knew the small inflation ball should be close to the end but had to dig around a little to find it because it was buried inside some way.

The raft inflated normally although not to the point of being tight. The first time I tried getting aboard over the small end, a wave dumped me out. On my second try, boarding was easy. Once in the raft, turned on my mae west light and hooked up my lanyard. I hollered some more for the NAO and he answered. I lay down in the raft and started to paddle in the direction of his voice but didn't move. Remembered the emergency pocket was supposed to be tied to the raft. Felt around underneath and located the parachute cord tied to the packet and pulled it aboard. Lay on my stomach again and then paddled the raft over to the NAO some 100 to 150 feet away.

Can't remember for sure but believe the NAO was sighted first when an S-2 came over with searchlight on, a welcome sight.

The NAO asked if I thought he could get into or on my raft with me and I said he probably could. *(He did not have his raft lanyard hooked up to his parachute and had to leave the sinking aircraft without it—Ed.)* He lay across the large end of the raft and I sat in the other end with one leg dangling in the water. I think we could both have gotten in the raft completely if necessary.

We talked awhile about the whole situation. Neither of us fired any more tracers or flares because we wanted to save them in case the flares dropped previously burned out. It seemed like a fair amount of time before we spotted a helicopter coming towards us. If I remember correctly, he went by and then came around again. Fired two tracers and a night flare so he could sight us more easily.

As the helicopter came in to hover with the sling lowered, we decided to get out of the raft so we wouldn't be blown away by rotor wash. As we entered the water, my left leg became entangled in the parachute line on the emergency packet which had fallen out as we went over the side when the raft tipped. My pistol, hanging from its lanyard, also got caught in the line. Then the life raft lanyard became wrapped around my right leg. Neither one of us had a knife available. I didn't have mine along because I had considered it a hazard in the zippered pocket of my anti-exposure suit. The NAO had a knife but it was in a flight suit pocket underneath his anti-exposure suit. So I just hung on to the raft and waited for a chance to get back into it to untangle myself.

The helicopter made several passes. At one time I thought the NAO had the sling. He swam toward it but the spray blinded him. The helicopter seemed to move a slight distance away so I rolled into the raft and proceeded to untangle myself. (*A rapidly developing fog was obscuring the smoke flares and the reflective tape on the survivors' helmets at this time, the Rescue Report states.—Ed.*)

Rather than have my pistol catch something again and because I was having a considerable problem with the lanyard catch, I put the pistol in my anti-exposure suit pocket. My mae west prevented my putting it back in the holster. (I had previously blown my mae west up real tight.)

I was lying in the raft, my back to the helicopter, when the NAO said, "Hey, the helicopter is landing in the water." I looked around and saw a large light proceeding towards us. It looked as if we were going to be run down. I think both of us tried to paddle out of the way. The helo apparently over-

shot and made some maneuver to come toward us again.

This time I was prepared. The helicopter sponson was aimed right at me and the helicopter came in nice and slow. I grabbed the nose of the sponson and proceeded hand over hand down the side. After passing the sponson, I remember seeing the NAO reaching for a hand up and then I saw a crewman. I grabbed a rack just inside the large cargo hatch and hung onto it while the crewman pulled the NAO aboard. Then the crewman grabbed my arm and pulled me in. I either brought the raft part way in with me or reached back and pulled it aboard after I was inside the helicopter.

We had been in the water for 31 minutes. . . .

The two survivors—now in the helicopter—were not quite through with their day.

By the time the helo took off in a smooth sea with six-foot swells, fog was solid from water to 500 feet. Due to the heavy fog, and after six unsuccessful CCA approaches to the ship the helo was forced to bingo to the beach.

The helo pilot credits the speedy organization of the rescue effort by the on scene commander as a major factor in its success. Due to the rapidly deteriorating visibility, any loss in time in marking the position of the ditching would have gravely affected chances of sighting the survivors. Another major factor, he says, was the reflective tape on the pilot's and NAO's helmets. Without it, visual sighting would have been virtually impossible as the fog began to thicken.

The investigating flight surgeon's comments summarize survival deficiencies in this accident:

The NAO did not have his parachute strapped on because he considered it a hazard in initiating an escape from beneath the air controller's radar scope. Apparently this is common practice among air controllers flying in the EA-1E. He found himself in a sea survival situation with a minimum of equipment to substantiate existence. . . . He exposed himself to a potentially fatal situation after a successful ditching and egress.

It is well recognized that the effectiveness of the anti-exposure suit is greatly reduced by the presence of water in its interior. Both men had water inside their suits. In both instances it is believed to have entered via the neck. The neck of the pilot's suit was fully zippered but water still entered. The NAO had the neck of his suit completely zipped except for the terminal inch and a half as is the case with many aviators because of discomfort. Thus, both would have been subjected to a reduced survival time from exposure had it not been for their rescue. (Air temperature was 58° F., water temperature 59°.)

The NAO carried his sheath knife in his flight suit beneath the anti-exposure suit, making it inaccessible for use. The pilot did not take his knife on the flight because it was uncomfortable in the leg pocket of his anti-exposure suit and he was afraid it might catch on something in the cockpit during an escape. Thus, the pilot would have found himself in a potentially fatal situation when he became entangled in lines prior to rescue if he had not been able to re-enter the raft and get untangled.

The pilot had no personal survival kits. His PSK-2 had not been replaced on his mae west following its inspection in anticipation of the SEEK kit replacement. The NAO had only half of his PSK-2 kit. (The squadron has had considerable difficulty in obtaining the newer SEEK kits.)

As in the past, considerable slipperiness of the flight gloves was experienced when they became wet. The pilot had trouble locating his raft inflation toggle because the gloves reduced his sense of touch.

The water landing rescue made by the pilot of SH-3A helicopter was probably lifesaving to the survivors. The rapidly deteriorating weather at the survival site could well have prevented location and rescue of the survivors in time. However, both survivors felt they could have reached the rescue sling if more slack had been allowed to play out and the sling had been left floating on the water. The sling appeared to be always just off the surface and the survivors would not leave the security of the raft and swim to it.

The flight surgeon had a number of survival recommendations:

- Continued emphasis on required survival equipment, the proper wearing of the equipment and familiarization with its use to maintain a state of safety readiness.
- Investigation of the need for a more comfortable and watertight neck on anti-exposure suits.
- Investigation of the necessity of redesigning one of the pockets on the lateral thigh of the anti-exposure suit to specifically accommodate the survival knife.
- Re-evaluation of the technique of reaching survivors with the rescue sling when they are clinging to a raft being blown by rotor downwash.
- Readvising pilots and aircrew to inflate their mae wests once they are safely clear of the downed aircraft.

SEA OF FLAMES

FOR pilots and aircrewmen who are remiss in wearing gloves and flying with helmet visor down, here is part of the statement of a flight surgeon who made the same mistake. When the T-1A in which he was riding as observer stalled at low altitude after takeoff, he ejected. He landed in the fireball and suffered second degree burns of the face and second and third degree burns of the hands.

"All of a sudden the nose pitched down . . . then I heard the pilot yell 'EJECT!' I ejected. (It was his tone of voice that made me react so fast. . . . I had never heard that tone of voice from anybody. . . .)

"I felt three severe jolts. They seemed to be about a second apart. . . . The seat worked beautifully. I remember tumbling backwards. I don't remember seeing the chute open. Then, as I rotated forward, I saw I was coming down into this big sea of flames about 20 to 40 feet high. It all happened very fast. I still had on my seat pan and torso harness.

"I wondered what it was like to die.

"As I saw the flames coming around me, I decided I wasn't going to give up. Then there was a hard jolt. This was when I landed. I looked down at my hands. I was lying in a sea of flames.

"I tried to run out of the flames, (a distance of) about 30 yards. I got out of the flames and fell down. I tried to get my rocket jet fittings open but this was pretty hard to do since my hands were badly burned. I finally got them open. Then I put some distance between me and the plane in case it blew up. I started walking away yelling for the pilot. I got no answer. . . .

"Two ironic things: (1) I was burned on my hands and this is the first time I ever flew in a jet aircraft without taking off with my gloves on. (2) This was the first time I ever flew with my visor up and not down."

notes from your flight surgeon

Tired Mech

EVERYONE admires and respects a can-do spirit, but this spirit can compromise good sense and safety when it requires maintenance personnel to work 15 to 18 hours a day for a prolonged period. Guidelines for limits on maintenance work must be prepared and followed by maintenance supervisors as flight hour limits for flight personnel are adhered to by flight supervisors. An over-tired mechanic can be as hazardous as an over-tired pilot but the results of his fatigue may be much less obvious.—*Safety Council Minutes.*

Lack of Training

ABOARD a helicopter on a photo reconnaissance mission, a chief photographer wearing a gunner's belt was taking pictures of a trawler when the helo began to spin and lose altitude. He tried to pull himself back into his seat, but before he could do so, the aircraft hit the water with a thud. The helo flipped and immediately filled with water. Some 10 feet below the surface, he grabbed the port hatch edge and pulled himself out of the aircraft.

When he surfaced, he was still holding the 50-pound aerial camera and *was still strapped in the gunner's belt attached to the sinking aircraft.*

An alert aircrewman saved the day.

"At first, I couldn't figure out why the Chief didn't swim away," he said later. "I pulled on him only to find that he was still strapped in his gunner's belt. I undid the belt and I think I inflated his life vest."

Now free, the chief, still holding on to his camera, began to swim away from the wreckage. As the camera began to fill with water it became harder and harder for him to stay afloat. Finally, he let it go.

The survivors were rescued by the Japanese trawler which they had been photographing and subsequently were transferred to a destroyer whaleboat.

The investigating flight surgeon attributed the chief's failure to release his gunner's belt to a lack of current training in ditching procedures.

Training requirements for air crewmen can be found in OpNav-Inst 1510.4D, 20 April 1964.

Vest Testimonial

FROM *an MOR on a case of a hard landing followed by fire*: "This man's Mk-2 life vest apparently provided just enough protection from the heat and flames to spare him any back burn. There is a sharp line of demarcation on his waist where the second degree burns start down to his buttocks and legs. This piece of gear was tested after the accident and despite the fact that it was seared, blistered and partially melted, it fired, inflated and held air. The Mk-2 life vest is a wonderful piece of equipment."

Unsuitable Suit

THOUGH the horizon at sea was poorly defined, a pilot in a T-33B attempted an aileron roll over water in a seaward heading. He became disoriented and scooped out of the roll about three-quarters of the way around. During the high-G pullout the student in the rear seat lost consciousness. Although the pilot did not black out, he had trouble holding his head up. Both men were wearing Z-1 anti-G suits.

The student remembers his peripheral vision closing in and his head falling forward. Shoulder straps were locked and anti-G suit connected. He does not remember the anti-G suit inflating. On regaining consciousness he had vertigo and slight nausea. He also felt pain in his upper back and neck, probably from hyperflexion during unconsciousness.

After the pullout, the pilot's accelerometer read 5.5 positive Gs; the student's registered 10. No explanation could be found for the variation in readings. Both instruments checked out in any range from 10 positive to 5 negative with a max error of 0.2 G.

Investigators considered the student's anti-G suit useless because of a loose fit. He had failed to readjust it in the switch from winter to summer flight clothing. The suit also had a small leak. In addition, in the flight surgeon's opinion, the student's G-tolerance was further decreased by an inadequate personal fitness program.

Turbo Props

ON BOTH flight decks and airfields, walking into or backing into a spinning prop is an ever-present potential hazard. At this writing, VAW-11 is already operating turbo props and VAW-12 will have them in a few months. *Turbo props increase the hazard of propeller injury.* Why? Because when a turbo prop reaches the zero pitch angle there is very little prop wash to warn you of its presence. Because of the lack of prop wash you will *not* be as conscious of the danger as you would with conventional reciprocators.

So if you work around turbo props, remember: there are two potential hazards, jet blast and that giant cleaver.

Spectrometric

The spectrometric method of analyzing engine oil for its metallic content proves to be a reliable aid in preventing inflight power plant and helo transmission failures.

To date successes in spectrometric oil analysis have been mainly in analyzing conditions of reciprocating, turbo-prop and turbo-jet engines and helicopter transmissions. By this method impending failures were predicted before advancing to inflight failures. Numerous reciprocating engines have been repaired in the field by replacement of a cylinder instead of replacement of an entire engine. The technique is also applicable to constant speed drives, cabin superchargers, gear boxes, hydraulic systems and other oil-wetted mechanical systems.

The concept originally employed by railroads for determining the condition of diesel engines has been pioneered and developed for aviation use by BuWeps. The technique has emerged from the experimental stage and is now an established program, the details of which are contained in BuWeps Instruction 4730.8.

Currently, the NAS Pensacola O&R laboratory is the only naval facility providing Oil Analysis Service. Plans call for eight additional laboratories to provide worldwide service to operating activities. Units in the Carribean area are being serviced by a private contractor in San Juan, Puerto Rico.

In addition to performing oil analysis service for any Navy activity desiring such service the Pensacola lab services all of the Presidential aircraft operated by the Air Force, Army and Marines. Service is also furnished the Coast Guard, the 934th AF Troop Carrier Squadron and to the AF Tactical Air Command. Services were also furnished the Army until it established its own lab recently at Fort Rucker, Alabama.

As a testimonial to the benefits of this technique, the AF requested oil analysis service to all TAC aircraft, as a result of outstanding predictions of impending J75-P19W engine failures in F-105 aircraft. Because of these predictions, all TAC F-105s were grounded briefly until the Pensacola lab could analyze samples from each engine. As these samples

c Oil Analysis

by John M. Ward
Bureau of Naval Weapons

were analyzed, those aircraft which were normal in wear patterns were returned to an operational status. The AF reported that every engine suspected of being discrepant by the Navy lab was in fact discrepant. Each was substantiated by a Tear Down Report. This is just one more instance where lab technicians far removed from the operation of an aircraft, could predict malfunctions before the malfunctions progressed to the point of inflight failure.

The program gives the operator a degree of assurance that no unknown discrepancy is developing in his engine, providing another margin of safety and confidence for the operator.

Testimonial

Since the writing of this article, reports indicate this new laboratory technique has turned up seven unsuspected engines in the Presidential air fleet which may have been on the verge of breakdown. Among these was a bad bearing on Air Force One, the President's personal airplane.

The other six involved were backup aircraft of that fleet including, until recently, some single-engine helicopters. The oil analysis method brought to light two faulty transmissions in the Presidential rotary-winged fleet which were undetectable by other means.

A

B

Concept and Application

Under certain conditions and within certain limitations, the internal condition of any enclosed mechanical system can be evaluated by spectrometric analysis of lubricating oil samples from the system. The concept and application are based on the following facts:

a. *Metals used in aircraft mechanical systems.* The components of aircraft mechanical systems contain aluminum, iron, chromium, silver, copper, tin, magnesium, lead and nickel as the predominant alloying elements.

b. *Wear metals.* The moving contact between the metallic components of any mechanical system is always accompanied by friction. Even though this friction is reduced by a thin film of oil, some microscopic particles of metal do wear away and are carried in suspension in the oil. Thus, a potential source of information exists that relates directly to the condition of the system. This conclusion is developed as follows: First, the chemical identity of the worn surfaces and the particles worn from those surfaces will always be the same. Second, if the rate of production of each kind of metal particle can be measured and established as being normal or abnormal, then the rate of wear of the contacting surfaces will also be established as normal or abnormal, and the chemical identity of the abnormally produced particles will provide clues to the identity of the components being abnormally worn.

R2000-4 reduction drive pinions. Pinion A in satisfactory condition; B severely worn; C and D with scoring on faces of gear teeth. Oil analysis showed high iron, chromium and copper.

C

D

R1820-86A piston pin plug right, with flaked area on thrust button. Oil analysis showed high aluminum.

Normal Production of Wear Metal

Under normal conditions, the rate of wear will be constant and quite slow and the wear metal particles will be microscopic or submicroscopic in size, so that the particles will remain in suspension in the lubricating system.

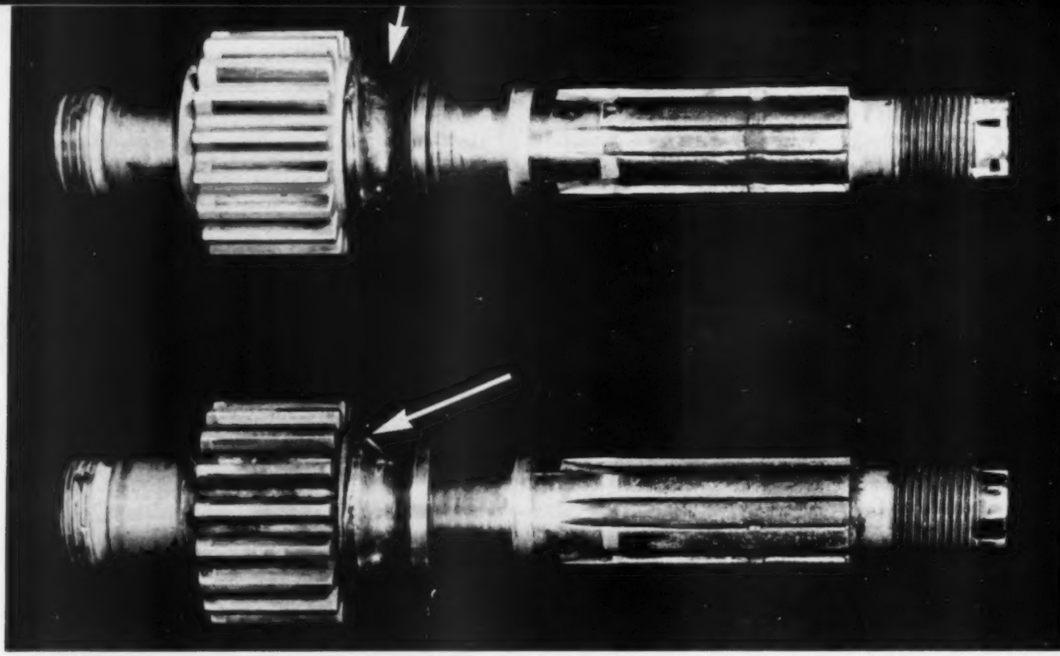
Accelerated Production of Wear Metals

Any condition, which alters the normal relationships or increases the normal friction between the moving parts, will also accelerate the rate of wear and increases the quantity of wear particles produced. If the condition is not discovered and corrected, the deteriorative process will continue to accelerate, usually with secondary damage to other parts of the system, to eventual failure of the entire system.

Identification and Measurement of Wear Metals

All of the important wear metals produced in an oil lubrication mechanical system can be separately

R1820-76B piston below, with damaged upper ring land caused by a broken piston ring. Oil analysis showed high aluminum and iron.



R985-14B impeller shaft and bearing assemblies with mutilated bearings (arrows). Oil analysis showed high iron and aluminum.

measured in extremely low concentrations by the spectrometric analysis of oil samples taken from the system.

Silver is accurately measured in concentration down to one-half part by weight of silver in 1,000,000 parts of oil. Most other metals are measured accurately in concentrations down to two or three parts per million. The maximum amount of normal wear has been determined for each metal of the particular system in the program. This amount is called its "threshold limit of contamination." It is measured by weight in parts per million (PPM).

It must be understood that the wear metals present are of such microscopic size that they are not visible to the naked eye, cannot be felt between the fingers, and flow freely through the system filters. For example, wear metals one-tenth the size of a grain of talcum powder, are easily measured by the spectrometer. The spectrometer therefore measures the particles that move in suspension in the oil and are too small to be captured by either the oil screen or chip detector.

The spectrometric method of analysis for metals content is possible because metallic atoms and ions emit characteristic light spectra when vaporized in an electric arc or spark. The spectrum produced by each metal is unique for that metal; thus, the position or wave length of a spectral line will identify the particular metal, and the intensity of the line can be used to measure the quantity of the metal in a sample.

How the Analyzer Works

Periodic samples of used oil are taken from all equipment protected by the program and sent to the Oil Analysis Laboratory. Here is a brief description of how the spectrometer (Fig. 1) measures the wear metals present in the used oil samples:

(1) A film of the used oil sample is picked up on the rim of a rotating, high-purity, graphite disc electrode (A).

(2) Precisely controlled, high voltage, AC spark discharge is initiated between the vertical electrode (B) and the rotating disc electrode burning the small film of oil (C).

(3) Light from the burning oil passes through a slit which is positioned precisely to the wave length for the particular wear metal being monitored. (See Fig. 2.)

(4) As the light passes through the slits, photomultiplier tubes transform the light waves electronically into energy which automatically prints the analytical results in parts per million on punch cards on the laboratory record sheets.

(5) The results are interpreted and when a sharp trend or abnormal concentration of metal is present, the participating activity is notified by pri-

ority telephone or message, depending on the urgency.

Benefits

The Oil Analysis Program is not a cure-all. Normal maintenance practices must still be followed. There are, however, several side benefits of the program worth mentioning.

As an additional inspection on completed maintenance. Analysis of oil samples after a maintenance action has been accomplished can be used as a confidence indicator or quality control tool by the maintenance officer to assure that the maintenance task was performed correctly and did correct the original discrepancy. An analysis continuing to show abnormal concentrations of wear metals present in the system would be positive proof that maintenance had not corrected the discrepancy and further trouble-

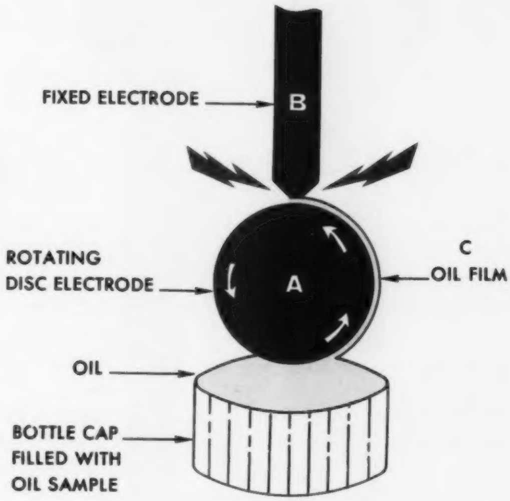
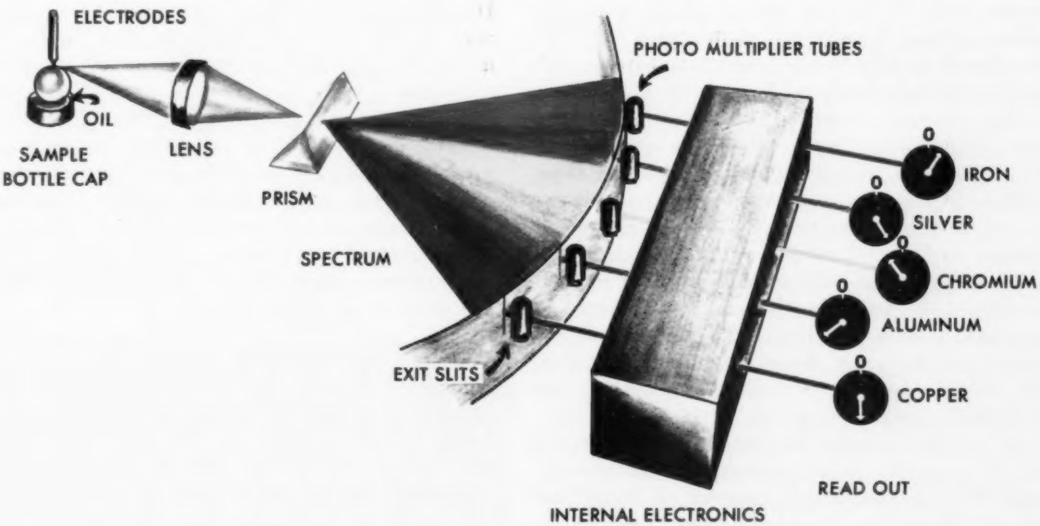


Fig. 1

Fig. 2

ANALYSIS TECHNIQUE



R1820-86A exhaust valve guide and retainer sleeve. Note scored condition of sleeve. Oil analysis showed high iron and aluminum content.

shooting techniques must be employed.

To detect design deficiencies. Many catastrophic failures destroy the actual design deficiencies by false evidence. For example, the Army had several crashes of the H-23 helicopter caused by the transmission locking. Examination of the failed transmission showed that the needle bearings had frozen and the needles were blued and fuzed together. Redesign of the bearings was started. At the same time the Army requested the Pensacola lab to sample each of the grounded H-23 helicopters and advise of those with the highest concentration of metal contaminant. Several samples were abnormally high in metal contamination. Upon disassembly inspection, the Army found a spacer had worn causing misalignment and binding of the needle bearing which had started to turn blue from the binding action. Redesign of the spacer and change of material solved the problem. The culprit was not the high priced bearing but a relatively inexpensive spacer.

As a quality control for metallic content of new oil. A number of recent samples contained extreme concentrations of silicone. Samples of unused oil also contained this extreme content. Investigation found a qualified oil producer had changed his oil formula and was using silicone as an anti-foam agent. This could not be detected by the normal inspection and acceptance methods employed under the oil specification.

Analysis of samples from engines on test stands. This procedure has reduced the possibility of installing a newly overhauled engine in the aircraft containing discrepancies undetected by test stand instruments.

Justification for extending or reducing time removable items. One of the most recent proposals and cost effectiveness aspects of the program is the elimination of hourly forced removal of items. It has been proposed that engines remain in service as long as the wear metal concentration remains within normal wear patterns established for the particular engine regardless of operating hours.

At Your Service

The Oil Analysis Service is furnished free to naval activities desiring to participate. Read BuWeps Instruction 4730.8—ask your film library for the Oil Analysis Movie MN 9585 and show it. Understand the principles of the oil analysis technique and use the oil analysis program—it is a valuable asset to maintenance and provides an additional margin of flight safety.

ACCIDENT INVESTIGATION

By CDR D. M. Layton, NASC

Investigations of aircraft accidents are usually made with a view toward finding the cause of the mishap. Too often this is the only value gained from the inquiry, even though there may be a subconscious relating of cause to prevention.

Looking for cause, for cause's sake alone, has dangerous potential. Even the purist will have to agree that the only justification for manpower and money expended in accident investigation is accident prevention. The connection between cause and prevention is too often too loose to be worthwhile, possibly because investigators are not always as thorough in their recommendations as they are in their investigations.

Let us consider an elementary example. An aircraft loses directional control and crashes. A thorough investigation by the accident board discloses that a bolt is missing from the rudder linkage. This bolt is normally secured with a nut which is cotter-pinned to the bolt. Cause of the accident—missing cotter pin. Recommendation of the board—insure that cotter pins are installed.

Will this recommendation serve as a preventive? No.

Now, let us suppose that the board digs deeper into the matter of the missing cotter pin (cause) and determines that this particular assembly was last worked on by Bluecap, AM3 (fault). Now that they have definitized the cause by introduction of fault, their recommendations are deeper in scope:

- Insure that the cotter pin is installed properly
- Insure that Bluecap, AM3, installs the cotter pin correctly

These recommendations still fall short of the mark in minimizing repetition of accidents due to this cause, since it's possible that this squadron's next accident may result from some *other* fastener being left unfastened or because Bluecap, AM3, left a nut off of a different bolt.

What preventive measures could have been recommended as a result of this mishap? Several might be in order:

- A system of doublechecks to insure security of fasteners in critical systems
- A reemphasis of quality control procedures

In its deliberations, perhaps the board should also search for plausible answers to such questions as:

- Is there a simple means of installing the bolt so that the cotter pin is readily visible?
- Is there available a satisfactory replacement fastener that would eliminate human error?
- Is there an alternate flight control system that would permit control of the aircraft, even after the assembly in question failed?

Finding the answers to these questions and correcting any shortcomings they expose would be much more important to accident prevention than simply discovering the cause or fault of the mishap and letting it go at that.

Since we're suggesting that the accident board publish more thorough and all-encompassing recommendations in their AAR, why not provide them with a checklist as a guide? It might contain the following items:

- Have recommendations been made that, if adopted, would prevent a similar mishap under similar conditions?
- Would these recommendations, if adopted, also prevent a similar mishap under any conditions?
- Would these recommendations, if adopted, also prevent mishaps of a different nature?
- If the answer to the preceding question is no, could the recommendation be revised so as to provide affirmative answers to all of the first three questions?
- Are the recommendations made in a manner that will require the least expenditure of money, fewest changes in procedures and material, smallest number of man-hours and the maximum benefit to the naval service?

If the recommendations in your accident report answer the above questions in the affirmative, chances are that your efforts may prevent future accidents, far more costly in terms of injury and damage, than your own.

Investigation is not only a path to determination of the cause; it is also a stepping stone toward the ultimate goal—*prevention of aircraft accidents!*

Remember, too, that after you've tailored your recommendations to correct the deficiencies listed as cause factors, direct those recommendations to the agency that can take the desired actions.

X-Rays Help New Planes

No longer is it necessary for the subject to strip when an aircraft undergoes a check-up nor—come the worst—is it necessary to resort to old-fashioned "sawbones" techniques to discover what's giving trouble beneath that rib. For nowadays, with the means at hand, "When in doubt, X-ray" has become routine philosophy.

Radiographic (X-ray) inspection of fatigue test specimens has now made possible a comprehensive routine of such inspection in the maintenance schedule of a new aircraft. The first example of this concerned the *Britannia.* Future possibilities of this type maintenance inspection are bright and promise spectacular savings in time and trouble.

In modern aircraft where such items as wings, tail-planes, fins, elevators and control-tabs are becoming increasingly difficult—if not impossible because their structure is of a "blind" nature—to inspect by other means, radiographic techniques are the answer. Because this method obviates the need to strip down—in "blind" structures this is impossible anyway—and examine a part visually, it offers a tremendous saving in time and expense in determining structural condition. Also the integrity of blind riveting no longer need be taken for granted, and cracked or bent rivets and any unwanted bits left inside a tab or an elevator can be seen by the magic eye.

The first recorded X-ray inspection of a completed aircraft structure was conducted at Woolwich Arsenal where glued wood joints were radiographed during World War I. On this occasion the work was taken to the X-ray equipment and it was not until 1930 when certain parts of the airship R. 101 were radiographed in position that the procedure was reversed.

Suggestions first made in 1936 that X-rays might be used in the maintenance inspection of aircraft gained little support and were shelved until after the war.

One of the first companies to adopt X-ray techniques was Vickers-Armstrong who have now used them in the laboratory for some 14 years, although it is only during the last 2½ years that these methods have been in daily use.

Some idea of the time saving offered by using X-ray techniques can be gained from the fact that only 14 hours are required for inspection of one area of a *Viscount,* whereas a visual examination would take 500 hours.

X-ray techniques are now being employed on *Comet* and *Vanguard production* lines, to name just two, and, following current tank-testing of an *Argosy,* they will be introduced in the production of this aircraft also.

The success of X-ray inspection has already led to proposals to delete in new designs certain access panels used during service overhaul check because they will no longer be needed. Very big savings in time and effort have already been achieved in cases where defect is found in one aircraft and all others of the same model have to be inspected for it. The use of the X-ray eye in such cases may clear in an hour or two an aircraft which might have been out of service for as much as a week if conventional methods of inspection had been used.—*BOAC "Sky-Liner"*

TIRE TOOL TALE—Steel bar, above, inadvertently left inside tire assembly during tire buildup caused blowout, below, during takeoff of an A-3. *Moral*—Account for all tools and hardware after every job.

Golfing Off

AN AIRMAN goofed when he bounced a golf ball on the hangar deck. As the ball came down, it struck the top of an UH-2B rotor blade. Damage in the form of a dent required replacement of the rotor blade.

The role of the supervisor and experienced personnel is highlighted in this mishap, notes the commanding officer. The complexity and costliness of modern aircraft and equipment make it imperative that each individual be personally on guard against any unthinking act of his own as well as that of others. Anyone observing an irresponsible act should immediately take corrective action.

Inconsistencies

REPORTS and inquiries sometimes question what appear to be either discrepancies or inconsistencies of similar procedures which are given in different technical manuals. A typical case in point would be a report containing the following statement:

> The engine starting procedure in the —1 Flight Manual, the —2 Maintenance Manuals, and the —3 Engine Overhaul Manual are all different. Request the applicable manuals be changed to make them consistent with each other.

In the foregoing example and in similar instances, the change as requested cannot be made. Why? The reason is, of course, that each of the three referenced manuals is written specifically for a certain type personnel and for different engine operating conditions. The following examples will serve to clarify this further:

a. *The Flight Manual*

This publication provides a pilot with the starting procedure and limits of an engine which has been, and is, operating normally in an airplane. This procedure may not be as detailed as, and the limits may be greater than, those shown in either the —2 or —3 manuals.

b. *The Maintenance Manual*

This publication provides a pilot or flight mechanic with the starting procedure for an engine in an airplane which:

(1) Is not operating properly.

(2) Is a new or overhauled engine, or an engine which has had maintenance work performed and starting is being accomplished for the first time.

(3) An operational check is being made of the engine starting or engine ignition system.

These conditions (1), (2) and (3) obviously require a more complete procedure and the limits specified are normally more stringent than those listed in the Flight Manual.

c. *The Engine Overhaul Manual*

This publication provides overhaul personnel with the starting procedure for an engine in a test stand (not in an airplane). Limits specified for a newly overhauled engine are, in many cases, the same as the manufacturing limits (versus service limits in the —2 Maintenance Manual.) Also these limits do not take into consideration particular airplane installation requirements (duct losses, air extraction, cooling, fuel flow, . . .).

When comparing procedures and/or limits between various manuals, it should be noted to whom the procedure is directed and its exact purpose. To illustrate, the chart used by the corner automobile service station is different than the shop manual used by the automobile dealer or by an authorized factory garage. In addition, it is also different from the data used by the manufacturer.

The foregoing is not intended to convey the thought that there are not unavoidable inconsistencies which result because of the time lapse between publication dates of manuals, or because of typographical errors. This last condition should rightfully, of course, be brought to the attention of those personnel responsible for the preparation of publications.—*NAA "Service News"*

Letters

Want your safety suggestion read by nearly a quarter of a million people in naval aviation? Send your constructive suggestions to APPROACH.

Stop APU Fuel Leaks

Santa Ana, Calif.—Auxiliary power units in UH-34D helicopters all leak gasoline. The leaks seem to come mainly from the gas cap and the fuel shutoff valves which are less than best for their purposes.

Everybody knows about this hazard but tends to disregard it. I've got a feeling that someday a spark will ignite this leaking gas and *then* something will be done about it.

Before this happens I suggest: (1) Replacing the present gas caps with automobile type caps that seal around the edges yet provide a vent; and (2) Replacing leaking screw valves with a simple non-leak petcock.

MCAF MOUSE

• Your suggestions are worth trying. Your letter helps, but remember BuWeps Inst. 4700.2 says in effect "If it's no good, FUR it."

Pin Stowage

NAAS Meridian—While in training here I have noticed that the majority of plane captains are in the habit of placing the landing gear pins in the angle-of-attack probe cover. This practice can impair safety of flight because dirt, grease and other foreign material from the pins can be wiped off into the cover and, in turn, work into the probe air holes.

To minimize such a possibility this command now manufactures bags, providing plane captains a means of keeping the three pins together.

R. H. DECKER, ENS
VT-7

• Good go—simple solutions are usually the best.

Frostbite/Smoking

FPO, San Francisco—In the September 1964 issue of APPROACH, I was interested and concerned when I read the article on page 35, "No Smoking, Please!" The statement that concerns me is:

"It has been proven that the nicotine in tobacco is a potent vasoconstrictor which causes blood vessels to tighten up and reduce the flow of blood. By smoking just one standard-size cigaret, the skin temperature of your foot will be lowered about 5° F. This constriction of the small arteries occurs also in other vital organs, such as the heart and kidneys."

Has the fact that the skin temperature of the foot being lowered about five degrees been made known in survival manuals? If not, I believe this fact should be published.

I believe that smoking may make a downed pilot or crew member more susceptible to frostbite. Do you have any information to justify my belief?

Knowledge of normal body functions that may be altered by drugs, narcotics, and so on, should be known to all flight personnel for their own safety. If smoking would make a person more vulnerable to frostbite, I'd like to know.

MICHAEL A. MALONEY, AMS2, USN
AIRANTISUBRON FORTY-ONE

• Thank you for your thoughtful letter on the possible relationship of smoking in a winter survival situation and frostbite. The article to which you refer in the September issue was a reprint from the 5th Air Force Safety News. Consequently, we are unable personally to verify the statement that smoking one cigaret can lower foot temperature about 5° F. We cannot find this statement in any survival manual. Other available information is as follows:

In Vol. 9, No. 10, Army Aviation Digest, Capt. W. H. King, USAF makes the statement, ". . . nicotine can also constrict blood vessels and if you're still smoking two packs a day, perhaps you'd best fly southward like the geese." The implication here seems to be in line with your thoughts on the subject.

The following excerpt from an article by Mr. Bradford Washburn, Director of the Museum of Science in Boston, from the Polar Record, Vol. II, No. 75, Sept., 1963, discusses the question more fully:

> **"Because impaired local circulation is the primary cause of frostbite, an effort should be made at any altitude to avoid anything that is known to have even a mildly adverse effect on normal peripheral circulation, in particular tobacco and alcohol. Smoking results in varying degrees of spasm**

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

The State of . . . Aviation Safety

In the interest of improving naval air readiness through the prevention of naval aviation mishaps with consequent loss of personnel, aircraft and equipment, the Naval Aviation Safety Center will sponsor the Fourth Aviation Contractor's Safety Representatives Conference with the theme of **"The State of the Art of Aviation Safety."**

The conference will be held at the Golden Triangle Hotel in Norfolk, Virginia, on 6, 7 and 8 April 1965.

Industry management officials, as well as manufacturing personnel responsible for the functional areas of aviation safety, engineering and human factors research, are cordially invited to register in advance, and participate in this conference.

This conference is designed to provide recommendations to problems affecting naval aviation safety. Committees are arranged to permit members to exchange information and to discuss possible solutions to the problems. Attendees request assignment as to their area of primary concern upon registration.

Committees will be organized and will consider agenda items in the area of human factors, maintenance, operations, personal safety and survival equipment.

in the blood vessels throughout the entire body, thus reducing normal peripheral circulation and the flow of oxygen and nourishment to the tissues, at a time when both are badly needed. On the other hand, alcohol results in vascular dilatation and in increased flow of blood at the surface of the body. This blood is unduly chilled and, as it returns to the heart and lungs, may lower the temperature of the whole body significantly. Although the use of alcohol (even in moderation) is not recommended at any time on the trail—particularly in an emergency—smoking does not seem to have any direct bearing on frostbite, if one does not smoke actually at the times when the danger of frostbite exists or while it is being treated. Habitual heavy smokers do not appear to be more subject to frostbite than others."

Incidentally, your squadron flight surgeon should have a reprint of Mr. Washburn's lengthy and excellent article on frostbite in Nos. 7, 8 and 9, Vol. 44, USN Medical News Letter, Oct. - Nov. 1964. We believe you will find it very interesting.

Vol 10 **approach** No 9

Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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CREDITS

Cover painting of F-4s in flight by Chuck Witcher, courtesy McDonnell Aircraft Corp., St. Louis, Mo.

Page 37 U. S. Air Force Photo.

Purposes and policies: Approach, published monthly by the U. S. Naval Aviation Safety Center, is distributed to naval aeronautical organizations on the basis of 1 copy per 10 persons. It presents the most accurate information currently available on the subject of aviation accident prevention. Contents should not be considered as regulations, orders, or directives. Material extracted from mishap reports may not be construed as incriminating under Art. 31, UCMJ. **Photos:** Official Navy or as credited. Non-naval activities are requested to contact NASC prior to reprinting Approach material. **Correspondence:** Contributions are welcome as are comments and criticisms. Views expressed in guest-written articles are not necessarily those of NASC. Requests for distribution changes should be directed to NASC, NAS, Norfolk, Va. 23511 Phone: Area Code 703, 444-3641 (days), 444-2929 (Nights, Weekends, Holidays) Att: Safety Education Dept., if you are receiving the magazine free because of military or commercial contract status with the Navy. . . . IF YOU ARE A PAID SUBSCRIBER, address all renewals and change of addresses to Superintendent of Documents, Washington, D. C. 20402. **Subscriptions:** Single copy 35 cents; 1-year subscriptions $3.50; 2 yrs., $7.00; 3 yrs., $10.50; $1.00 additional annually for foreign mailing. **Printing:** Issuance of this periodical approved in accordance with Department of the Navy Publications and Printing Regulations, NAVEXOS P-35. Library of Congress Catalog No. 57-60020.

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The Ballad of Roger Ball

Now, as any aviator will tell you, "Roger, Ball" is merely an acknowledgement from the carrier that they understand "Roger" that the aircraft is lined up with the "meat ball" and ready for a landing.

However, when the comma is taken from the "Roger, ball" acknowledgement, it takes on a kind of personification and inspired a BORDELON crewmember to write this ode to the heroic "fellow" whose name, at least, is present at all flight operations:

Throughout the day, we monitor the CCA.
Whose name stands out above the rest?
Who never seems to feel distressed?
By whom is BORDELON impressed?
Roger Ball.

Be it jet, or Fudd or even Stoof—
As each plane rounds into the groof—
Who states his name with savoir faire
With pear-shaped tones coming o'er the air?
Who never seems to have a care?
Roger Ball.

What type of man, this aviator,
Who works through movie call and later?
Is he a Hercules in might
With eyes that pierce the blackest night?
A paragon who is always right
Roger Ball.

We're sure that Moms throughout the nation
With sons who serve with dedication
Would rest secure if they could know
Of this man who seems to make things so . . .
This steadfast, staunch and sturdy pro
Roger Ball.

Courtesy USS BORDELON DD881

Safety
is
like
a
prop;
it

Professionalism pays off!

See oil analysis page 36